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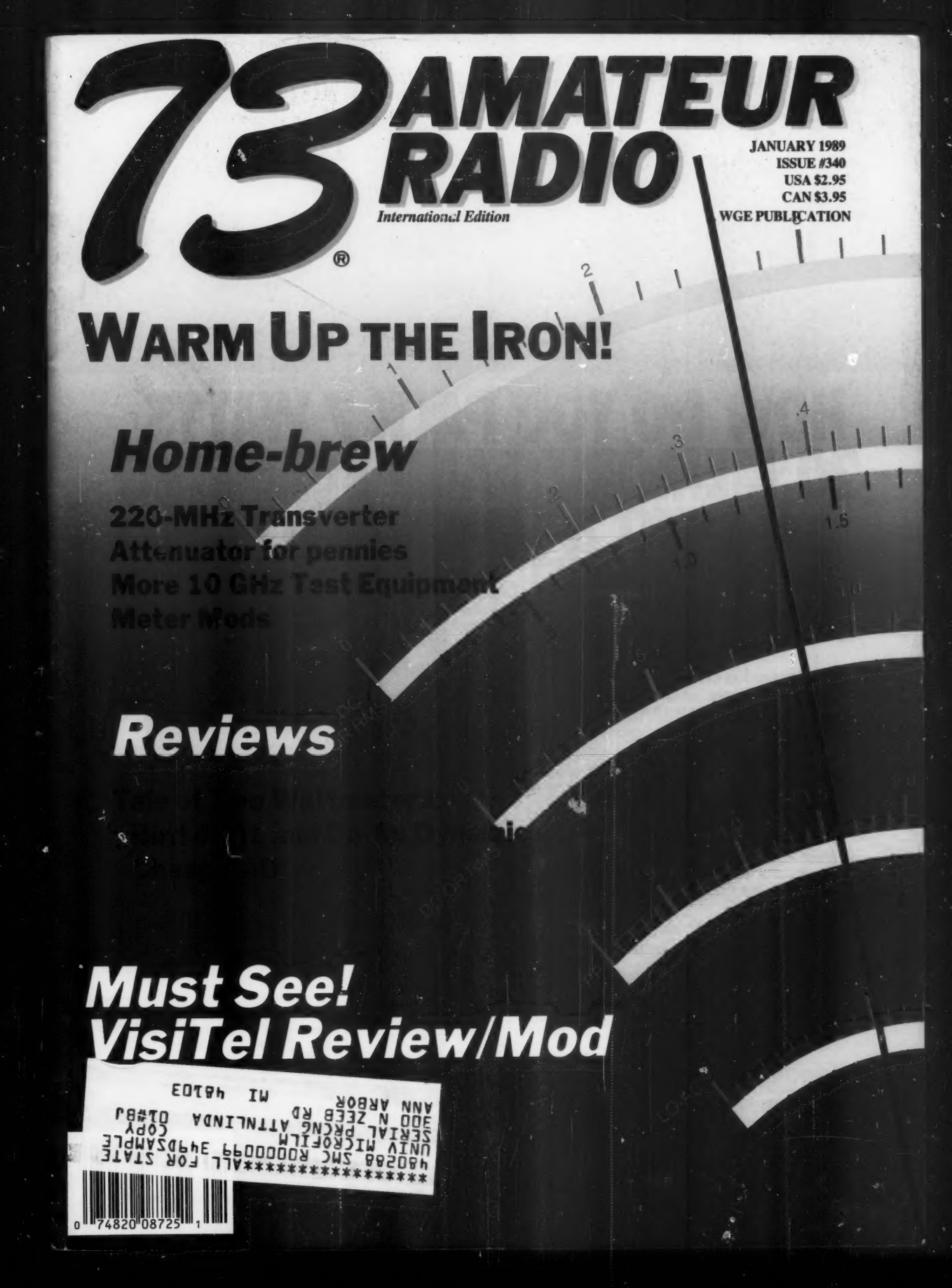

WARM UP THE IRON!

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- **20 Memories.** Store any frequency, Tx offset and subaudible tone in any memory. Total flexibility!
- **Programmable Scanning** of band and memories plus easy lockout and instant memory recall.
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CIRCLE 354 ON READER SERVICE CARD

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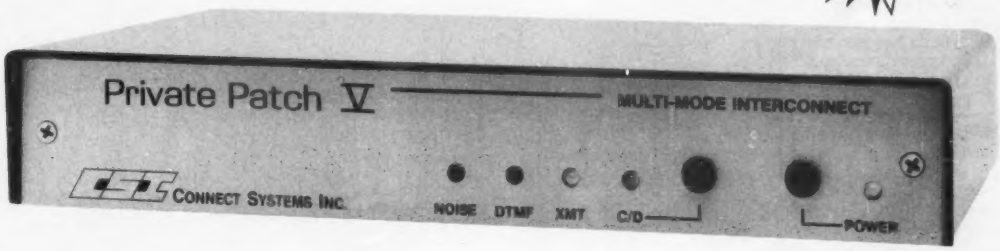

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Private Patch V achieves a level of sampling patch performance unobtainable in any other product. Crucial to performance is the noise squelch filter. Compare our five pole filter to the competition's two pole filter. Advanced software algorithms perform noise correlation tests which result in greater useable range than the competition. Nine selectable VOX enhancement ratios allow you to vary performance from straight sampling to highly VOX enhanced. (sampling rate decreased while the land party is speaking). The mobile is in full control and can break-in at any time.

2. SIMPLEX VOX PATCH

VOX mode offers superb simplex operation with any radio, including synthesized and relay switched models. VOX mode has other advantages too. **1.** A linear amplifier can be used to extend straight simplex range. **2.** You can operate through any remotely located repeater to greatly extend range. **3.** If desired you can connect Private Patch V to the MIC and speaker jack of your radio. NO INTERNAL CONNECTIONS ARE REQUIRED. Control is maintained automatically with built-in dial tone detection, busy signal detection and fully programmable activity and time out timers. An optional electronic voice delay board eliminates first word clipping with slow switching radios.

3. DUPLEX PATCH

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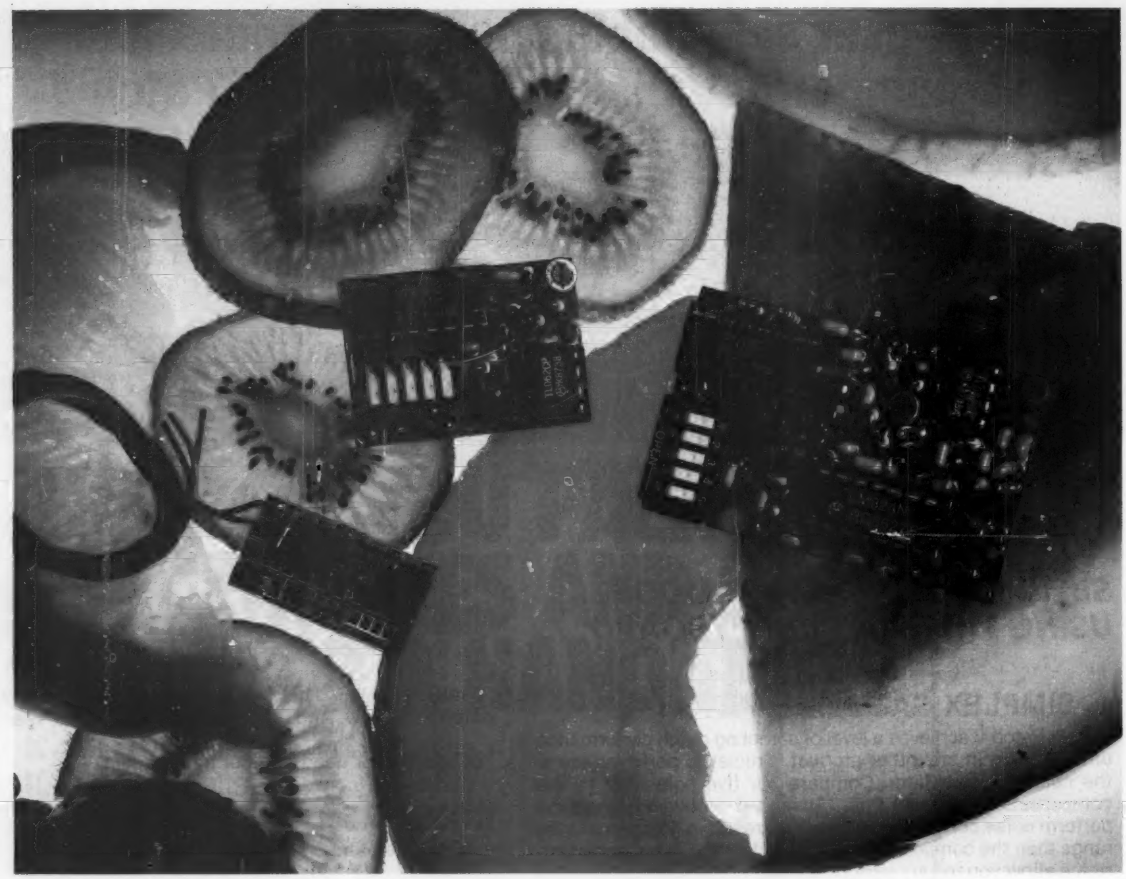

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Now you can have it all! Take all the qualities you've come to depend on in our programmable CTCSS tone equipment: Astonishing Accuracy, Instant Programming, Unequaled Reliability; and add full spectrum tone versatility, multi-tone capability without diodes, a reprogrammable memory... It's our new harvest of CTCSS tone equipment.

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Call today toll-free and find out more about this fresh new flexibility in tone signalling, and don't forget to ask about multi-tone switching without cumbersome diode networks or binary switches.

It's all brought to market by the people who introduce the freshest ideas in tone signalling, and of course our customary same day shipping and one year warranty apply.

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CIRCLE 10 ON READER SERVICE CARD

MFJ TUNERS

Invest in the world's finest 3 KW roller inductor tuner with dummy load, new *peak* reading Meter and more . . .

MFJ-989C **$349.95**

The MFJ-989C is a compact 3 KW roller inductor tuner with a new **peak** reading Cross-Needle SWR/Wattmeter. The roller inductor lets you get your SWR down to absolute minimum.

With **three continuously** variable components -- two massive 6 KV capacitors and a high inductance roller inductor -- you get precise control over SWR **and** the widest matching range possible from 1.8-30 MHz.

You get a **new** lighted **peak** and average reading Cross-Needle SWR/Wattmeter with a **new** more accurate directional coupler.

You get a giant two core balun wound with teflon wire for balanced lines and a 6-position antenna switch with extra heavy switch contacts.

You get a 50 ohm 300 watt dummy load for tuning your exciter, a tilt stand for easy viewing and a 3-digit turns counter plus a spinner knob for exact inductance control.

Its compact 10¾x4½x15 inch cabinet slides right into your station.

The MFJ-989C is not for everyone. However, if you do make the investment, you'll get the finest 3 KW tuner money can buy -- one that will give you a lifetime of use, one that takes the fear out of high power operation and one that lets you get your SWR down to absolute minimum

MFJ's *Best* VERSA TUNER II

MFJ-949C **$139.95**

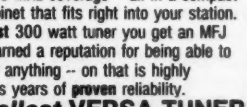
The MFJ-949C gives you more precise matches than any tuner that uses two tapped inductors. Why? Because you get two **continuously** variable capacitors that give you infinitely more positions than the **limited** number on switched coils.

This gives you the precise control you need to get your SWR down to a minimum. After all isn't that why you need a tuner.

You also get a dual range lighted Cross-Needle SWR/Wattmeter, 6-position antenna switch, 50 ohm 300 watt dummy load, balun for balanced lines and continuous 1.8-30 MHz coverage -- all in a compact 10x3x7 inch cabinet that fits right into your station.

With MFJ's **best** 300 watt tuner you get an MFJ tuner that has earned a reputation for being able to match just about anything -- on that is highly perfected and has years of **proven** reliability.

MFJ's *smallest* VERSA TUNER



MFJ-901B **$59.95**

The MFJ-901B is our smallest -- 5x2x6 inches -- and most affordable) 200 watt PEP Versa tuner -- when both your space **and** your budget is limited. Matches dipoles, vees, random wires, verticals, mobile whips, beams, balanced and coax lines continuously 1.8-30 MHz. Excellent for matching solid state rigs to linears. Efficient airwound inductor. 4:1 balun for balanced lines.

144/220 MHz *VHF* TUNERS

MFJ-920 **$49.95**

MFJ-921 **$69.95**

MFJ's newest VHF tuners cover both 2 Meters and the new Novice 220 MHz bands. They handle 300 watts PEP and match a wide range of impedances for coax fed antennas. MFJ-921 has SWR/Wattmeter.

MFJ's *Fastest Selling* TUNER

MFJ-941D **$99.95**

The MFJ-941D is MFJ's fastest selling 300 W PEP antenna tuner! Why? Because it has more features than tuners costing much more and it matches everything continuously from 1.8-30 MHz.

It matches dipoles, vees, verticals, mobile whips, random wires, balanced and coax lines.

SWR/Wattmeter reads forward/reflected power in 30 and 300 watt ranges. Antenna switch selects 2 coax lines, direct or through tuner, random wire/ balanced line or tuner bypass. Efficient airwound inductor gives lower losses and more watts out. Has 4:1 balun. 1000 V capacitors. 10x3x7 inches.

MFJ's *Mobile* TUNER

MFJ-945C **$79.95**

Don't leave home without this **mobile** tuner! Have an uninterrupted trip as the MFJ-945C **extends your antenna bandwidth** and eliminates the need to stop, go outside and readjust your mobile whip.

You can **operate anywhere in a band and get low SWR.** You'll get maximum power out of your solid state or tube rig and it'll run cooler and last longer.

Small 8x2x6 inches uses little room. **SWR/ Wattmeter and convenient placement of controls make tuning fast and easy while in motion.** 300 watts PEP output, efficient airwound inductor, 1000 volt capacitors. Mobile mount, MFJ-20, $3.00.

2 KW COAX SWITCHES

MFJ-1702 **$19.95**

MFJ-1702, $19.95. 2-positions. 60 dB isolation at 450 MHz. Less than .2 dB loss. SWR below 1:1.2.

$29.95 **MFJ-1701**

MFJ-1701, $29.95. 6-positions. Unused positions grounded. For desk or wall mount.

MFJ's *1.5 KW* VERSA TUNER III

MFJ-962C **$199.95**

For a **few** extra dollars, the MFJ-962C lets you use your barefoot rig now and have the capacity to add a 1500 watt PEP linear amplifer later.

Two **continuously** variable 6 KV capacitors give you **precise** control for getting your SWR down to a minimum. And **lots of inductance** gives you the widest matching range possible.

You can read both **peak** and average power with the lighted 2-color Cross-Needle SWR/Wattmeter. A **new** directional coupler gives you more accurate readings over a wider frequency range.

Has 6-position **ceramic** antenna switch and a teflon wound two-core balun with ceramic feedthru insulators for balanced lines. 10¾x4½x14 7/8 in.

MFJ's *Random Wire* TUNER

MFJ-16010 **$39.95**

You can operate all bands anywhere with any transceiver when you let the MFJ-16010 turn any random wire into a transmitting antenna. Great for apartment, motel, camping operation. Tunes 1.8-30 MHz. Handles 200 watts. Ultra compact 2x3x4 in.

MFJ *artificial* RF ground

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You can create an artificial RF ground and eliminate RF "bites", feedback, TVI and RFI when you let the MFJ-931 resonate a random length of wire and turn it into a tuned counterpoise. The MFJ-931 also lets you electrically **place a far away RF ground directly at your rig** -- no matter how far away it is -- by tuning out the reactance of your ground connection wire.

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CIRCLE 24 ON READER SERVICE CARD

Welcome, Newcomers!

This month's column is devoted to a different kind of newcomer—the home-brewer who has not yet published his or her project.

Is Home-brew Really Dead?

Some hams seem to think so—or at least they think that this activity has shrunk to the domain of a small core of dedicated hackers and techno-peasants. These hams poured forth with all the "logical" reasons. They cited, for example, the increased availability of sophisticated commercial equipment, the growing "Grab-It-Now" ethic in our (American) society, and the influx of less technically-oriented members into our ranks because of relaxed licensing requirements. Do we now sound the death knell for home-brewing?

It's In The Cards

Our reader feedback responses fly in the face of the above reasoning.

Each month, I read through the stack of monthly reader feedback cards. (These are found in between the pages of the magazine.) On these, we ask the readers to rate the editorial content of the issue on a three-level scale of "Great," "OK," and "No Way." Below the rating grid, we ask in what areas they would like to see more, and see less. The responses ranged from DC to daylight, but one item came up through the noise floor loud and clear: MORE SIMPLE CONSTRUCTION ARTICLES.

Recently, we began sending our readers, along with their subscription mailings, a more detailed satisfaction survey. *Three out of four* of the returns echo the same message: MORE SIMPLE CONSTRUCTION ARTICLES.

Many of these are not just polite, offhand requests. They are out-and-out demands, scrawled in bright red caps across the card. It's clear to us the readership *clamors* for the nuts-and-bolts of this hobby; the simple tale that tells how to build a simple project; the "this is what I did and how I did it."

What To Do?

Since so many of you *want* to build, then a goodly number of you *have already built* one or more projects. Yet we receive relatively few manuscripts on light home-brew projects despite many lures: showing off your project to over 100,000 readers, getting paid quite well for it, having a nice feather to stuff in your resume (for you are now an "authority" on the subject), and even enjoying the warm, fuzzy feeling of carrying out an important part of our mandate set forth by the FCC, that of furthering and disseminating the state of the art. Why is it that so many of those who design and build don't put their brainchilds to paper?

It's true some home-brewers simply can't be bothered. Yet many I've talked to really want to write, but are convinced they can't—even those who have never tried! The next section attempts to dispel common confidence-blockers.

The Four Fallacies

Fallacy #1: "I don't have the talent to write."
Reality: This statement assumes that writing and design and building are fundamentally different skills. Actually, they're very closely related!

A home-brewer usually systematically executes an idea—he sketches out the project in block diagram form, then works out the circuit details within each block, then interfaces the circuit blocks. He first works out the plan generally, and then in gradually greater detail.

Effective writing is no different! You first sketch out a general three-point outline, in which you include sub-outline points (see below), and then you fill in the details under each outline point.

Introduction
- What led to the birth of this idea?
- What are its advantages?

Main Body of Text
- Circuit theory and description
- Parts List
- Where to obtain parts
- Step-by-step construction sequence
- Construction caveats

Conclusion
- Summarize the project, highlighting its advantages.

Fallacy #2: "My project is too simple or too left-field for anyone to want to bother with it."
Reality: The simplest projects are often the best! Remember, too, the project the veteran home-brewer passes over is often right up the greenhorn's alley. *73* strives to present a range of simple-to-challenging home-brew projects.

The readers, too, always surprise us. Many so-called marginal projects became popular beyond our wildest imaginings. Woe to us in Editorial if we ever stop surveying the readership, thinking we "really know" what the reader wants!

Finally, our readers often read through something simple and short, even if they have no immediate plans to build it. How often have you wanted to find an article published years back? We run a thriving article reprint business here.

Fallacy #3: "My schematics, parts placement diagrams, etc., are too poorly drawn to appear in a magazine."
Reality: You may have noticed a consistency in the style of our printed figures—they're the work of our excellent draftsman. Bill's been with *73* from the beginning—there's not much he hasn't seen!

Fallacy #4: "No editor will wade through my awful grammar and spelling."
Reality: Often, it's not as bad as you think. Even if it *is*, you're in good company—many noted writers, such as Ernest Hemingway, were terrible spellers. Most had editors, like you do—us! Fortunately, there are many checks, both on the author's and editor's side.

First, write or call for, or download from CompuServe, our Writer's Guide.[1] By following the Guide and the outline above, we can more easily estimate your meaning through context. Be sure to clearly state your objective both in the cover letter and in the Introduction of the article. If the idea is strong, we go to great lengths to show it the light of day.

Second, more and more authors have access to microcomputers with enough memory to run spelling checker programs. We have been using WordStar's sophisticated spelling checker for many months, and we will be using, by this printing, "Grammatik III"—a program that analyzes text for several dozen different common grammatical problems.

Third, on particularly confusing points, we call you for on-the-spot clarification. (Be sure to include a phone number on your cover letter!)

Fourth, when your article is scheduled and prepared for a given month, we send you copies of the final edit for your review. These are called Author's Proofs. *Rarely* are there problems at this stage. Nonetheless, conscientious authors read these carefully in the event that a major fault or two remain.

Finally, you may want to team up with a writer. It can be a very effective, even synergistic, relationship. Some of our authors do this, with wonderful results. The article payment split two ways is often more than offset by the time saved and the enjoyment.

Let's Hear From You

It should be clear that most writing problems are imagined, and the real problems are most often very manageable. If doubts remain, call and talk with us—we're friendly and receptive, and we're here for you. Ditto if you want to home-brew and write, but are not sure where to start. We have a stack of letters from readers looking for a myriad of different designs.

Remember: *If you can design or build it, you can effectively write about it*—and everyone will be the richer for it! 73

. . . de NS1B

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[1] *The* 73 Magazine *Writer's Guide is available on CompuServe's HamNet, Library 0, filename* "73WRIT"

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73 AMATEUR RADIO

JANUARY 1989 Issue # 340

TABLE OF CONTENTS

FEATURES

44 Hacker's Shack
Where hardware fantasy and reality meet. N4RVE

50 Trouble-shooting Guide For Switching Power Supplies
Chart to help minimize trouble-shooting time. W9NGP

HOME-BREW

12 More Microwave Test Equipment For 10 GHz
Several more uses for the versatile detector mount. WB6IGP

14 Super Simple Attenuator
Very cheap—and variable! K3OF

18 The 220 MHz All-Mode Transverter
Hard-core home-brewer's delight. W6YUY

29 Cheap and Dirty Oscillator
Fast audio frequency source. VE1VQ

35 Inexpensive Marker Generator
Tightwad's way to stay in calibration. WB6DFQ

38 Which End Is Up?
Now it's a snap to find the co-ax short. W7RXV

40 C-64 Voltage Protector
Protect Commodore's chips from line over-voltage. W0YJO

58 New Uses For Old Meters
Tool any meter to read a variety of values. KC3YB

61 Simple LED Checker
Great starter homebrew project! ..... Thompson

REVIEWS

30 AutoSketch and Amateur Radio
Economy CAD for home and shack. VE6BGL

32 Bird Model 4381 RF Wattmeter
Nice complement to the venerable 43. ..... WB9RRT

36 VisiTel On-The-Air
Unique SSTV. W8ASF

46 Hamcall
Dial-up callsign directory. NS1B

80 Coaxial Dynamics Model 81000-A Directional RF Wattmeter
New kid on the block. KT2B

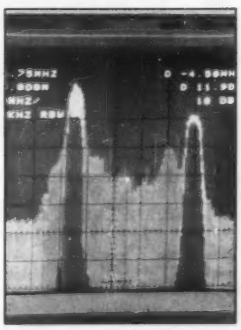
BOOK REVIEWS

54 1934 Official Short Wave Radio Manual
A don't-miss for nostalgia buffs. NR1A

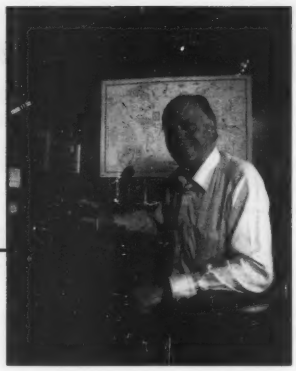
DEPARTMENTS

FEEDBACK... FEEDBACK!
It's like being there—right here in our offices! How? Just take advantage of our FEEDBACK card on page 17. You'll notice a feedback number at the beginning of each article and column. We'd like you to rate what you read so that we can print what types of things you like best. And then we will draw one Feedback card each month for a free subscription to *73*.

88 Ad Index
79 Above and Beyond
94 Ask Kaboom
53 ATV
85 Barter 'N Buy
82 Dealer Directory
17 Feedback
72 Ham Help
91 Hamsats
77 Homing In
86 Index: 1/89
60 Letters
6 Never Say Die
63 New Products
92 Propagation
71 QRP
9 QRX
59 RTTY Loop
98 73 International
66 Special Events
4 Welcome Newcomers



Cover by Deborah Smith



NEVER SAY DIE

Wayne Green W2NSD/1

Do We Fight Or Give Up?

Amateur radio has what growingly appears to be a terminal illness. What can we—what should we—do about it? We can try to pretend there's no real problem—ignoring the loss of new hams and our frequencies. We can give up. After all, there are plenty of other interesting hobbies—right?

Almost 30% of us have paid our dues to the ARRL—what more could possibly be expected of us? What can one person do that would make any difference?

The fact is, if you want to, you can have a profound influence—and not only toward saving amateur radio. In the process, you might be able to help solve some of America's growing problems. It's never going to happen if you wait for someone else to do it. Are we hams a bunch of wimps, willing to let our hobby die without a fight?

Yes, I know, hams are wimps when shown on TV. The ham on ALF is a megawimp, for example. But I haven't seen one single copy of a letter to the network, the producers or the show's advertisers protesting this outrageous defamation of our character. Are we wimps?

What are our resources? Well, we have about 400,000 reputedly alive and semi-alive licensed hams. About 50% are even remotely active. Now, if these 200,000 of us pooled our efforts, we'd mow 'em down. An average investment of $100 per ham would provide $20,000,000 to get some clout in Congress. $20 million toward re-election campaigns buys tons of clout in Washington. A $100 campaign donation buys about four thousand times the attention of a letter.

Just flexing our political muscles isn't going to save our hobby. At best it can stave off more frequency losses and give us a chance to start rebuilding the infrastructure the League almost totally destroyed 25 years ago. This was the network of thousands of school radio clubs that provided us with 80% of our newcomers—our youngsters. These clubs were virtually wiped out in 1963 by the ARRL's self-promoting Incentive Licensing proposal.

It's their thousands of school radio clubs that have fueled Japan's ability to provide their country with the engineers, technicians, and scientists with which they've destroyed our consumer electronic industry. If you read at all, you know that twenty years ago we produced virtually 100% of our consumer electronic equipment. Today, we make less than 5% of it.

Just Say No To'em

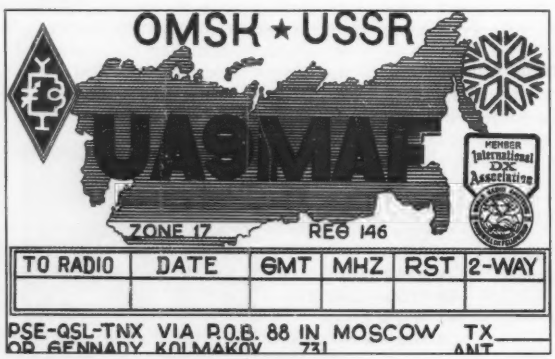
Yes, I know I've been on you about dieting and smoking—and I should be on you about alcohol too. I often throw guilt around about your lousy reading habits. Okay, I'm a nag. But I'm nagging for your benefit—and for amateur radio. Other than having you thank me at hamfests for having pushed you to slim down, exercise (get out there and walk every day), stop your drug habits (alcohol and nicotine—both of which shorten your life, make things miserable for others and waste money)—I don't get a lot of benefits.

Now, let's discuss drugs. I see you slurping 807s at hamfests. And don't think I don't see you trying to hide your cigarette as you try to sneak by the *73* booth with me glowering at you.

There's a lot of political excitement over our drug problems in America. And they're serious, I agree. But when we kill 30 times as many Americans with booze (and that mainly means beer) as we do with cocaine, heroin and crack combined, let's put this into proportion. Even worse is nicotine, that kills 60 times as many. I've lost a lot of friends to cigarettes and a few to alcohol, but none personally to drugs.

The only results of the war on drugs so far have been an escalating cost to the government and a steadily dropping of drug prices as ever more are smuggled in.

Continued on page 8



QSL OF THE MONTH

To enter your QSL, mail it in an envelope to *73*, WGE Center, 70 Rte. 202 N., Peterborough NH 03458, Attn: QSL of the Month. Winners receive a one-year subscription (or extension) to *73*. Entries not in envelopes cannot be accepted.

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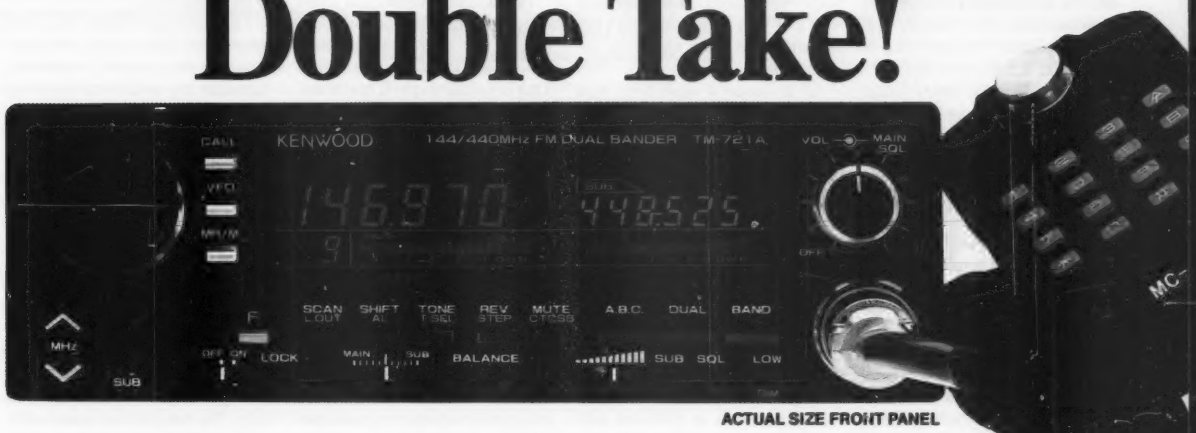
pacesetter in Amateur Radio

THE FIRST 144/220 MHz Dual Bander!

Double Take!



ACTUAL SIZE FRONT PANEL

TM-621A/721A

144/220 and 144/450 MHz FM Dual Banders

Once again, Kenwood brings you another Dual Bander First! The TM-621A is the first 144/220 MHz FM Dual Bander. The Kenwood TM-621A and TM-721A (144/450 MHz) re-defines the original Kenwood "Dual Bander" concept. The wide range of innovative features includes a dual channel watch function, selectable full duplex operation, 30 memory channels, extended frequency coverage, large multi-color dual digital LCD displays, programmable scanning, and more!

- **Extended receiver range** (138.000-173.995 MHz) on 2 m; 70 cm coverage is 438.000-449.995 MHz; 1-1/4 m coverage is 215-229.995 MHz. (Specifications guaranteed on Amateur bands only. Two meter transmit range is 144-148 MHz. Modifiable for MARS/CAP. Permits required.)
- **Separate frequency display for "main" and "sub-band."**
- **Call channel function.** A special memory channel for each band stores frequency, offset, and sub-tone of your favorite channel. Simply press the CALL key, and your favorite channel is selected!
- **30 multi-function memory channels.** 14 memory channels and one call channel for each band store frequency, repeater offset, CTCSS, and reverse. Channels "A" and "b" establish upper and lower limits for programmable band scan. Channels "C" and "d" store transmit and receive frequencies independently for "odd splits."
- **45 Watts on 2 m, 35 watts on 70 cm. 25 watts on 1-1/4 m.** Approx. 5 watts low power.
- **Automatic Band Change (A.B.C.)** Automatically changes between main and sub-band when a signal is present.
- **Dual watch function allows VHF and UHF receive simultaneously.**
- **Programmable memory and band scanning, with memory channel lock-out and priority watch function.**
- **Balance control and separate squelch controls for each band.**
- **Dual antenna ports.**
- **TM-621A has auto offset.**
- **Full duplex operation.**
- **CTCSS encode/decode selectable from front panel** or UP/DWN keys on microphone. (Encode built-in, optional TSU-6 needed for decode.)
- **Each function key has a unique tone for positive feedback.**
- **Illuminated front panel controls and keys.**
- **16 key DTMF mic. included.**
- **Handset/remote control option (RC-10).**
- **Frequency (dial) lock.**
- **Supplied accessories:** 16-key DTMF hand mic., mounting bracket, DC cable.

Complete service manuals are available for all Kenwood transceivers and most accessories. Specifications, features, and prices are subject to change without notice or obligation.

TM-721A shown with optional RC-10.

Optional Accessories:
• **RC-10** Multi-function handset/remote controller • **PS-430** Power supply • **TSU-6** CTCSS decode unit • **SW-100B** Compact SWR/power/volt meter • **SW-200B** Deluxe SWR/power meter • **SWT-1** 2 m antenna tuner • **SWT-2** 70 cm antenna tuner • **SP-40** Compact mobile speaker • **SP-50B** Deluxe mobile speaker • **PG-2N** DC cable • **PG-3B** DC line noise filter • **MC-60A, MC-80, MC-85** Base station mics. • **MA-4000** Dual band 2 m/70 cm mobile antenna (mount not supplied) • **MB-11** Mobile bracket • **MC-43S** UP/DWN hand mic. • **MC-48B** 16-key DTMF hand mic.

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Continued from page 6

The enormous profits involved assure that there are an unlimited number of potential criminals. Any "war" on drugs is un-winable.

Indeed, my proposed solution to America's drug problem would be to legalize drugs and sell all of them through state drug stores. And that means beer and cigarettes as well as cocaine and heroin. Further, I'd prohibit all advertising of these destructive products.

By controlling the sale through state stores we'd take the profits out of the drug industry. This would tend to stop the present pyramid sales system where addicts have to entrap new users in order to pay for their needs.

Once you take the profits out of drugs, you'll get crime out of the business. This could eliminate about 75% of today's crime for starters. And without the pressures of advertising and crime to get more customers, our educational programs to keep youngsters from trying drugs might take hold.

The barrage of ads pushing beer and cigarettes glamorizes these destructive drugs. Nicotine, being so viciously addictive, and our worst killer, has been difficult to fight. But even with the advertising and government subsidies (which are obvious government approval), tobacco use has been dropping.

Yes, I realize that the above is idealistic and that we live in a practical world where idealism doesn't pay off. If I were a crime boss I'd spend whatever it takes in congress to make sure that drugs are not legalized. This cash pressure makes it difficult for us voters to know whether a legislator has been bought or is driven by other convictions. We should remember that money will usually overcome even the most strongly held congressional convictions.

Newspapers, magazines, radio, and TV will fight every attempt to eliminate drug advertising—as will the bottlers, tobacco companies, distributors and retailers. We're talking a lot of campaign donations, so unless we get more information on who's paying off whom in Congress, we're going to keep killing hundreds of thousands of people a year with alcohol and nicotine.

Which is why I started by pointing out the value of investing in your legislators. Not even 200,000 of us can match the resources of the crime syndicates, so we probably can't do much about solving the stupid drug "war." But we sure can tip the balance when it comes to our losing more ham bands—at least until we can get amateur radio growing again.

Business Encroachment

The commercial pressures for our bands are growing rapidly. Communications is exploding and not just with fiber optics—it also means more radio spectrum will be needed.

UPS needs a system of high speed digital communications that will allow them to be in constant touch with every truck so they'll know at any instant where any package is. This means microwave satellite links, UHF repeaters, and frequencies. More and more businesses are going to demand the same depth of service and a bunch of aging old timers idling away what's left of their lives on 2m isn't going to stop progress for long.

High Definition TV, America's last opportunity to get back into consumer electronics, is going to need at least twice the bandwidth presently used. Do you think our present level of ham activity at 900 MHz is going to keep HDTV and other new services from being considered there?

The FCC is under strong pressure to open more UHF TV channels to make room for thousands more one watt TV translators—to extend TV into more small towns. And wait until we start with interactive TV!

Okay, I've proposed a step toward our holding our bands until we can get ham radio growing again. But without a practical plan for growth, we'll be spinning our wheels. Unless we come up with something good—and quickly—we're dead ducks.

Young Blood Needed

The ARRL has suggested working on getting more retired people licensed. Well, that's great for the retired—such an interest could keep them alive longer by giving them something interesting to do and helping them find new friends. I've no complaint with that.

But this isn't going to have any significant effect on our growth. Our growth has been a net 1% for the last five years—and that's if you don't admit that anyone has died. Even ten times that growth is too little. We need twenty to fifty times our present "growth."

I've mentioned that the number of new hams has been dwindling. The FCC figures show that they've dropped by 54% in the last four years! It's almost enough to worry a sensitive person. We need to get youngsters into the hobby. We even need to find a way to attract Black, Hispanic, and other minority youngsters. Yes, I have some suggestions.

I've already written too often, about the need for our ham clubs to work with their local schools to get school radio clubs restarted. This is happening in a few areas. I'd love to see some articles and pictures from clubs who have been successful in this. I know you're out there—you tell me about it at hamfests—but until you write about it, it's a well-kept secret.

We'd have more of a chance of attracting youngsters to amateur radio if our educational system hadn't self-destructed so badly. Part of the blame for this lies with TV, part with parents, part with teachers and their unions, and part with Dr. Spock and his let-the-kids-do-what-they-want philosophy that was fervently embraced by the yuppie generation. That's a lot of problems to solve.

Add to those the problems facing lower income families—the trap of welfare—the fast track of drug profits—the street gangs that entrap virtually every inner city youngster. If we're ever going to turn these kids into engineers, we've got a long row to hoe. We have to get the profits out of drugs, offer something more attractive than welfare as a way of family life, and replace street gangs with something more beneficial to the kids—and to society.

That's a lot to accomplish. Well, we've got 200,000 active hams, so we should be able to do a lot. And we can, if we want to. It depends on what's more important to you.

It seemed to me that we have three major problems with education. First, the present educational system hasn't encouraged teachers to make their material exciting to the students. I proposed to the new president of RPI, Dr. Roland Schmitt, and to the dean of the School of Management, Robert Hawkins, that Rensselaer initiate a study of teaching technology in order to find out what is working best in teaching productivity today. I was pleased that Dr. Schmitt has just announced the formation of a Center for Innovative Undergraduate Education. This will be "devoted to improving the quality and effectiveness of undergraduate education through innovative approaches in curriculum and course development, explorations of the role of technology in education, and partnerships that support science and mathematics education in primary and secondary schools." See *Electronic Engineering Times* 10/3/88 p.29 for the story.

I'm working through my *Congressional Technology Newsletter* to put pressure on Congress to consider my solution to the drug problem. The present demagoguery, with threats to bring in the military and embargo products from drug supplier countries isn't going to work. Our military is neither trained nor equipped for drug interdiction. And we don't want to retrain and re-equip them for this, since that would leave us without the strength to discourage the USSR from further adventurism.

The welfare mess? Of course I've got a good solution to this one—but not one that would work without solving the drug problem too. Here I looked for a similar situation that another country had solved successfully. There was a close parallel with Israel, to where millions of virtually destitute people suddenly immigrated. Israel put'em into kibbutzes where they were able to work together cooperatively. They farmed and started small manufacturing businesses—and were very successful at it. Their system for educating their children made them part of their communities and kept them from forming gangs. As the kibbutzes became successful they spun off entrepreneurs who started their own businesses.

I believe that we could get American businesses to buy shares in New American Communities that would encourage welfare families to move from the inner-city ghettos to farms. Surveys show that an overwhelming number of welfare families really want to work, but the system prevents it. I say it's time to change the system and give these people a chance to succeed. I also believe we should do everything we can to get their kids interested in setting up ham stations in every New American Community.

As part of the holding action to keep amateur radio from getting gutted while we're rebuilding our infrastructure, I've formed a National Industry Advisory Committee (NIAC) to work with the FCC Commissioners. Amateur radio

Continued on page 78

QRX . . .

EDITED BY BRYAN HASTINGS NS1B

Space Station Mobile!

There are, or soon will be, amateur radio operations from the Soviet space station *Mir*! Reliable Western European sources report that a 2 Watt 2 meter FM transceiver has been placed aboard *Mir*, possibly during a recent resupply mission. Sources also indicate that the crew has placed a ¼-wavelength ground plane antenna on the outer surface of the space station. The split frequency is not yet known.

The *Mir* cosmonauts have the callsign U1MIR. Amateur operations were planned to begin the first week of November.

A meeting was to be held in Moscow on Friday, 28 October, with Soviet authorities, to resolve schedule and frequency issues related to this activity.

Reports indicate that U1MIR will most probably be active for the duration of the stay of the current cosmonaut team aboard *Mir*. When a relief crew replaces the current team of cosmonauts, a 10 Watt 2 meter FM transceiver will likely be placed aboard *Mir* and the callsign of the operation changed to U0MIR.

Observers feel that operations from U1MIR/U0MIR will most likely involve international amateur radio contacts. Watch AMSAT news service bulletins for late-breaking details.

November March

Hams in Omaha, Nebraska, called on amateurs nationwide to join with them in the Save 220 MHz Protest Marches planned for Sunday, 27 November. According to John Gebuhr WB0CMC, one of the march organizers, the march's aim was to demonstrate the anger of radio amateurs over the FCC's decision to reallocate 220–222 MHz to land mobile business interests. The Omaha demonstration will have taken place in front of the federal court building, and hopefully in front of FCC facilities in those cities that have them, especially in Washington, DC. WB0CMC noted that television news organizations are always pressed to find newsworthy stories on this particular weekend, which is one of the reasons it was chosen.

It's interesting to note that this protest originated not in one of the areas where the 220 band is most heavily crowded, but in a part of the nation where the rapid growth on the band is just beginning.

Missile Restriction

The United States Army is testing a new missile guidance system in northern Alabama that will temporarily heavily restrict amateur operations on the 70 cm band in that area. The ARS shares the 420–450 MHz band with the government. Amateurs in Alabama are being requested to observe quiet hours up to five hours a day. As a result, at least three voice repeaters in Huntsville and Florence are off the air. Packet, fast-scan amateur television, and amateur satellite operations are among the other modes FOG-M affects. The hams are requested to make the job of the Army easier, and avoid further restrictions, by staying off the air.

According to David Black KB4KCH, a TV news reporter in Birmingham, the system is a new Fiber Optic Guided Missile (FOG-M), now under development at the Redstone Arsenal in Huntsville. Testing of FOG-M involves low-power airborne sensors. 70 cm amateur band use is only for testing purposes and will not be used when the system is actually deployed. The Army expects the tests to last into late December.

There have been mixed reactions about this from the affected amateur community. While most amateurs in the affected area say they are happy to cooperate, some claim that the Army has plenty of its own spectrum in which they could perform FOG-M experiments.

International News Snippets

Canada: The Radio Society of Ontario (RSO) has decided to disband. In announcing the decision following a special meeting on 15 October, RSO officials noted that many former RSO people were responsible for the creation of Canada's two National Amateur Radio Organizations—CRRL and CARF—and that these two groups were serving the needs of Ontario amateurs quite well. The matter will now be turned over to the RSO's solicitor (attorney) who will handle the legal aspects of disbanding and the distribution of the RSO's assets. These include the Clifford Marsh Amateur of the Year Award, which will be turned to CARF; and the Keith Russel and Rusty Brennan Field Day Awards which the CRRL administration will now handle. CRRL will also become sponsor of the RSO Ontario Amateur Radio Service Net (ONTARS).

Canada: Jack Ravenscroft VE3SR passed away 19 October, of a brain tumor.

You will remember Jack as the ham from Ottawa, Canada who was hauled into court by a neighboring family because they claimed VE3SR's operations caused interference to their home entertainment and consumer electronic gear. Jack spent thousands of dollars and four years fighting the case. With the support of the ham community, Jack finally won an appeal that will impact on the lives of every Canadian ham in a most positive way—Communications Canada (formerly DOC) is now considering mandatory RFI immunity standards for consumer electronics.

Ironically, the court-ordered RFI suppression on his neighbor's electronic gear was just being completed as Jack fell ill. Our condolences to Jack's family on their tragic loss.

Germany: The Radio Berlin International (RBI) DX Club provides its members with monthly forecasts for amateur and SWL DXers free of charge on request.

$$ HOME-BREW IV $$

73 Magazine again invites all home-brewers to turn their hot solder into cold cash and prizes, and to get their name in print to boot. All projects have a chance to appear in the magazine, and we will handsomely reward the authors of the *crème de la crème* of these.

Now for the bounty. Ramsey Electronics graciously contributed from their line of frequency counters. First prize is $300, a ten-year subscription to *73*, and a CT-125 1.25 GHz frequency counter. Second prize is $150, a two-year sub, and a CT-90 600 MHz frequency counter. Third prize is $75, a two-year sub, and a CT-70 525 MHz frequency counter. All this is in addition to the payment every author receives for publishing in *73*.

Contest Rules

1. Entries must be received by 1 April 1989.
2. To enter, write an article describing your best home-brew construction project and submit it to *73*. If you've never written for *73*, send an SASE for a copy of our Writer's Guide, or download it from CompuServe (Hamnet forum, Library 0., filename "73WRIT").
3. Here's the real challenge: The total cost of your project must cost under $73, even if all the parts were bought new. Be sure to include a detailed parts list with prices and sources.
4. Our technical staff will evaluate each project on the basis of originality, usefulness, reproducibility, economy of design, and clarity of presentation. The decision of the judges is final.
5. All projects must be original. That is, they must not be published elsewhere. There is no limit to the number of projects you may enter.
6. All purchased articles become the property of *73 Magazine*.
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Affordable DX-ing!

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HF transceiver with general coverage receiver.

Compact, easy-to-use, full of operating enhancements, and feature packed. These words describe the new TS-140S HF transceiver. Setting the pace once again, Kenwood introduces new innovations in the world of "look-alike" transceivers!

- **Covers all HF Amateur bands with 100 W output.** General coverage receiver tunes from 50 kHz to 35 MHz. *(Receiver specifications guaranteed from 500 kHz to 30 MHz.)* Modifiable for HF MARS operation. *(Permit required).*
- **All modes built-in.** LSB, USB, CW, FM and AM.
- **Superior receiver dynamic range** Kenwood DynaMix™ high sensitivity direct mixing system ensures true 102 dB receiver dynamic range.

- **New Feature! Programmable band marker.** Useful for staying within the limits of your ham license. For contesters, program in the suggested frequencies to prevent QRM to non-participants.
- **Famous Kenwood interference reducing circuits.** IF shift, dual noise blankers, RIT, RF attenuator, selectable AGC, and FM squelch.
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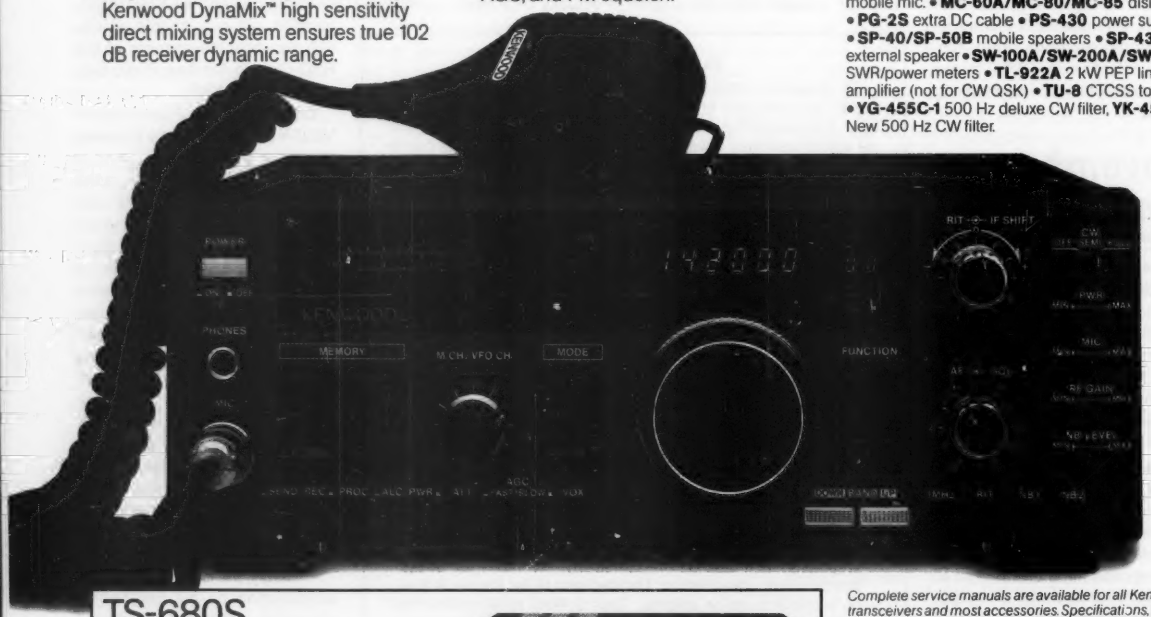
- **Selectable full (QSK) or semi break-in CW.**
- **31 memory channels.** Store frequency, mode and CW wide/narrow selection. Split frequencies may be stored in 10 channels for repeater operation.
- **RF power output control.**
- **AMTOR/PACKET compatible!**
- **Built-in VOX circuit.**
- **MC-43S UP/DOWN mic. included.**

Optional Accessories:

• **AT-130** compact antenna tuner • **AT-250** automatic antenna tuner • **HS-5/HS-6/HS-7** headphones • **IF-232C/IF-10C** computer interface • **MA-5/VP-1** HF mobile antenna (5 bands) • **MB-430** mobile bracket • **MC-43S** extra UP/DOWN hand mic. • **MC-55** (8-pin) goose neck mobile mic. • **MC-60A/MC-80/MC-85** disk mics. • **PG-2S** extra DC cable • **PS-430** power supply • **SP-40/SP-50B** mobile speakers • **SP-430** external speaker • **SW-100A/SW-200A/SW-2000** SWR/power meters • **TL-922A** 2 kW PEP linear amplifier (not for CW QSK) • **TU-8** CTCSS tone unit • **YG-455C-1** 500 Hz deluxe CW filter, **YK-455C-1** New 500 Hz CW filter.



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All-mode multi-bander

- 6m (50-54 MHz) 10 W output plus all HF Amateur bands (100 W output).
- Extended 6m receiver frequency range 45 MHz to 60 MHz. Specs. guaranteed from 50 to 54 MHz.
- Same functions of the TS-140S except optional VOX (VOX-4 required for VOX operation).
- Preamplifier for 6 and 10 meter band.

Complete service manuals are available for all Kenwood transceivers and most accessories. Specifications, features, and prices are subject to change without notice or obligation.

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QRX . . .

The forecasting method conforms to that used by the WARC-High Frequency Broadcasters Committee in Geneva, Switzerland. Membership application request must include three correct reception reports. For further information write to Radio Berlin International, DX Bulletin, 1160 Berlin, GDR.

Great Britain: Necessity is certainly the mother of advancement in amateur radio, all over the world. In England, a recent postal strike hampered the delivery of the Radio Society of Great Britain's (RSGB) GB2RS newscast script to its readers. The RSGB relied on other channels to distribute the document to its anchor people throughout the nation. They FAXed it to some 20 individuals, and made it available to the others via the Prestel database service and packet radio links. The system worked flawlessly, making the GB2RS newscast available to most British hams despite the postal work stoppage. That job action was finally settled on 12 September.

Great Britain: The Radio Amateur Invalid and Blind Club (RAIBC) announces the installation of a new telephone help-line. The number inside England is (01) 346-5372 and the line is open between 1000–1700 UTC each day to take calls from RAIBC members and supporters, as well as those wanting more information about this unique club. On those occasions when there is no one to take a call, an answering machine will record messages.

Israel: A reminder to those hams planning a visit to Israel. You can apply for a reciprocal license directly to the Ministry of Communications office in Tel Aviv, provided that your home nation has a reciprocal operating agreement with Israel. The Israel Amateur Radio Club (IARC) offers help to obtain this license and mail it to you. The IARC will also deliver it to you when you arrive. (See last month's "73 International," p. 103, col. 1.)

Several points to bear in mind: Repeater access in Israel requires a 91.5 Hz CTCSS encoder, and the country's main power is supplied at 230 V AC/50 Hz.

For further assistance, write to Aaron Kirshner 4X1AT, Box 4099, Tel Aviv, 61040, Israel.

Japan: Ham Fair '88—Japan's answer to the Dayton Hamvention—attracted 57,000 visitors to the Tokyo International Trade Center this year.

This is up some 3000 attendees over 1987, making a new record for this event. Highlights included the showing of the latest techniques and equipment for the 1.2, 2.4, and 5.4 GHz band operation. Seminar sessions included a short course in CW while various competitions, including a receiving contest, were also part of the festivities. Visitors to Ham Fair were also able to attend the Japan Amateur Radio Industry Association's "JAIA" Fair which featured the latest commercial gear.

Both exhibitions shared the same facilities this year.

Korea: The annual General Meeting of International Amateur Radio Union (IARU) Region Three took place in Seoul, Korea from 10–14 October 1988.

Approximately sixty representatives from twelve countries out of the twenty-four member societies of Region Three attended. The main topic discussed was preparation for a possible World Administrative Radio Conference as early as 1992. It's expected at that conference that many amateur allocations will come under attack from other spectrum-hungry users. They will also discuss actions on band plans for 160 and 80 meters in Region Three, beacon plans, satellite operations, contests, and emergency operations.

MACC Attack

The Big MACC is again on the attack. The Mid-America Coordination Council (MACC) voted to accept Colorado, the tenth state to join this group. In addition to Colorado, MACC oversees coordination activities in Kansas, Missouri, Illinois, Iowa, Minnesota, Nebraska, Oklahoma, South Dakota, and Wisconsin. These states encompass an area of 721,210 square miles, and contain almost 18% of the amateur radio population of the nation.

KC Coordination Dispute Settled

A long-standing dispute over amateur radio repeater frequency coordination in the Kansas City area has been laid to rest. Representatives of the Missouri Repeater Council, Kansas Amateur Repeater Council, and Mo-Kan Council of Amateur Radio Clubs, have initialed an agreement on how the frequency coordinators for the various parts of Missouri and Kansas should be listed in the ARRL Repeater Directory. The organizations have agreed also to exchange the information contained in their databases. Paul Grauer W0FIR, played a key role in resolving the dispute.

Full details on the settlement will appear soon in "Looking West."

Atlas

Herb Johnson W6QKI is the founder and chief designer of Atlas Radio, Inc. of Oceanside, California. He has asked *73 Magazine* to stress two points about his company, which was liquidated in late 1979.

1) When Atlas Radio was liquidated, it was not sold to any other company.

2) There is currently only one qualified service organization for original genuine Atlas Radio equipment. It is: RF Parts, 1320 Grand Ave., San Marcos, CA 92069; (619) 744-0728.

Big Thanks

Glen Baxter K1MAN, net manager for the International Amateur Radio Network (IARN) of Belgrade Lakes, Maine, gratefully thanks, on behalf of all the members of the IARN, all the manufacturers and individuals who donated equipment to help in the Hurricane Gilbert and future relief efforts. The Heath Company gave an IBM-PC compatible computer to the IARN, complete with a 20 MB hard disk drive; Advanced Electronic Applications donated a pair of PK-232 packet radio terminals; Hal Communications donated an ST-7000 communications terminal system; and Dr. Ernie Adams gave the group a Yaesu FT-757GX transceiver and power supply. Earlier, IARN received the donation of another ST-7000 from Tetsuju Yamada JA1EQZ who is chairman of E-Net and IARN Director for Japan. As the communications demand from Hurricane Gilbert diminishes, Baxter says that the gear will be assembled to serve as a full-time IARN HF Packet BBS on 20 meter, similar to one already in operation on 14.109 MHz by KB1PJ/8 in Cleveland, Ohio.

Glenn reminds all amateurs, especially contesters, that the 14.270–14.280 MHz segment is still very active for handling emergency traffic. While no longer protected by the FCC Mandate issued during Hurricane Gilbert, the IARN still uses 14.275 MHz to handle important medical emergency, relief, and health/welfare traffic.

ITU

A ham will be heading the United States delegation to the next major ITU conference. The State Department announced that C. Travis Marshal W3HPS has been appointed as Chairman of the US Delegation to the 1989 Plenipotentiary Conference of the International Telecommunications Union.

Marshall, who is a Senior Vice President of Motorola Incorporated, will attend the 23 May–29 June conference in Nice, France.

Thanks . . .

To all who contributed news items to this month's QRX column. They are: *Westlink, NABET News*, GB2RS, Radio Berlin, NO9X, AMSAT-NA, Tselil Harmomi, RSGB, ARRL, JARL, and CRRL. Keep your news items and photos rolling in! Address is: *73 Magazine*, WGE Center, 70 Rte. 202N, Peterborough, NH 03458-1194. Attn: QRX

More Microwave Test Equipment for 10 GHz

The Backfire Antenna/Boomerang

by C.L. Houghton WB6IGP

Microwave enthusiasts may recall my article in the October 1988 issue of *73* (pp. 40–41). In it, I describe how to build a 10 GHz detector mount to use with frequency measuring wavemeters and an amplifier. In this article, I will describe the backfire antenna or boomerang, its construction and operation, and the two meter injector. Both devices use a detector mount—either a commercial unit that accepts a 1N23 type diode, or the home-brew mount described in Part 1.

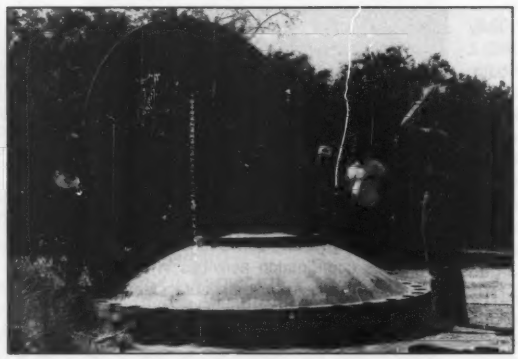

Photo A. Some members of the San Diego Microwave Society having a little fun with ten-foot dishes. Kerry Banke N6IZW with 10 GHz transceiver in hand.

The Backfire Antenna

Industry has used the backfire antenna for many years. Even some of the early amateur microwave pioneers in the 1940s used them. It's a simple concept and easy to apply—I've wondered why it hasn't surfaced earlier in some of our amateur radio publications.

The backfire, or boomerang, antenna is a waveguide-mounted detector to which a source of RF energy is directly inserted into the 1N23 diode, producing a flow of current. The RF comes from a single-stage 2N2222 transistor oscillator, crystal-controlled at 30 MHz (our IF frequency) for stability. This is all you need, besides a small horn antenna to receive and to act as the transmit antenna for the boomerang. You can build the oscillator or use an International Crystal oscillator board powered by a 9 volt transistor radio battery. See Figure 1 and system photographs.

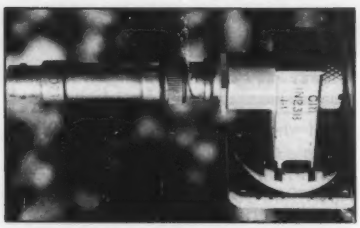

Photo B. Commercial mount with 1N23 type diode now fitted with varactor for connection to a 2-meter HT. Home-brew mount works just as well.

The 30 MHz signal injected into the detector diode mount by itself is not productive, but when it is injected with microwave energy via the horn antenna, it produces upper and lower mixer products detectable by your full-duplex transceiver. Modulation isn't usually detectable unless it is imposed on the 30 MHz oscillator. You will detect a return CW carrier when your antenna is pointed in the direction of the boomerang. You will detect modulation from the source when even when the boomerang is fairly distant from the Gunn oscillator. Signals at this point are very weak and are a result of the time/path differences.

With the microwave injection mixed with the 30 MHz oscillator, it doesn't matter which microwave frequency you use to obtain a return from the boomerang. I tried this same operation at other microwave frequencies, and operation is just as good as it is on 10 GHz. Design is not critical. Just use a resonant waveguide for the frequency and inject your IF frequency into the detector mount.

Ed Munn K6OYJ has even used a tin can fitted with a diode as part of a polaplexer for boomerang operation on our 3 GHz band. See Figure 2. When I finish my 5 GHz Gunn oscillator, I intend to build another boomerang out of some scrap 5 GHz waveguide, or possibly a used Sardine can, just for fun. If you don't play, how can you have any fun with these microwave bands?

IF System Required

The IF system must operate around 30 MHz. If your system uses a different intermediate frequency, change the crystal to match. Operation is the same. There will be some problems if your IF is high, say 100 MHz, because of the input matching and loading of the 1N23 crystal.

If you slowly separate the receiver and the boomerang, you will see a very defined peak, and as you move them further apart still, you will see a null. The phase difference between the 30 MHz signals, which can be used to measure distance, causes this change. You can also change the frequency of your microwave transmitter in small kHz steps and observe the null and peak at each frequency. You can measure distance from this.

Bore Sight

The boomerang or backfire antenna shines when used as a target for your antenna. With the unit perched at some distance, you can sight down the axis of your antenna and draw a straight line between the two. You can use it for antenna measurements to peak your system. Be sure your transceiver is on the frequency you wish to peak up, as it does not matter to the boomerang. As you increase the

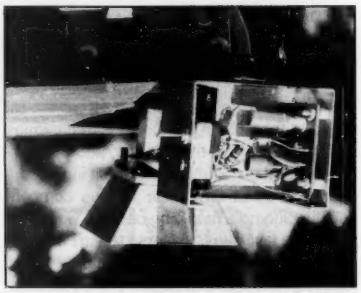

Photo C. Boomerang bottom view showing 30 MHz oscillator (International Crystal) mounted in small LMB box.

distance, you obtain a weaker signal and a much more defined antenna pattern. If the boomerang is moved about the front of your antenna, you will be able to detect the main lobe and the focus of the electrical axis. Moving around the sides, we would expect to see some side lobes, but the null and peak previously mentioned makes these measurements very difficult.

Just for fun, one day members of the San Diego Microwave Group gathered around several large dish antennas located in the backyard of Kerry, one of the members. We speculated on the pattern we would obtain if we tried a new frequency, DC or sound, instead of electronics. We moved our heads into prime focus and whispered to other members about a hundred feet away. Not bad. The gain of the ten-foot dish at audio frequency was very good, in fact. Stepping into the main lobe quite a distance away from the dish, you were soon pelted by very loud, focused sound—*full duplex!* You could whisper so low that a person standing three feet away could not hear you, yet the person at the feedpoint of the dish was copying solid and very loud. Now if we took the boomerang with a 1 kHz audio oscillator and . . . ?

When you know the distance your system will work at with a very narrow antenna beamwidth, try setting your microwave dish in a new spot, and then aim it at the boomerang with the 30 MHz oscillator turned off. When you think you are on target, turn on the boomerang and recheck for maximum signal and antenna orientation. This way you will become more familiar with the aiming characteristics of your antenna. I thought I was pretty good until I tried it, but I had to do some re-evaluating. It is like learning how to hold a camera steady when triggering the shutter. By dry-running the antenna, you improve your accuracy in pointing your system and make more contacts. One to two degrees beamwidth is not much to play with.

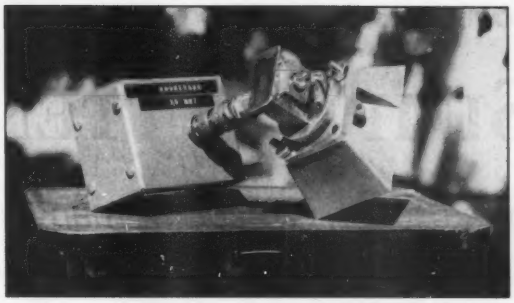

Photo D. Rear view of Boomerang showing back construction used on home-brew detector mount.

Use a map to point your dish antenna on distant points. Don't get one from your local service station; instead, obtain a quality survey map. US Geological Survey quadrangles describe in detail the topographic areas of interest from small to large. You'll also need a good compass. For aiming your antenna, Sears has several levels that will give you an indication of mount positioning and inclination. I found a General bubble bull's-eye level, the size of a quarter, at our local hardware store for $2.39. It has 45 degree markings and is quite sensitive. It proved useful in adjusting antenna orientation.

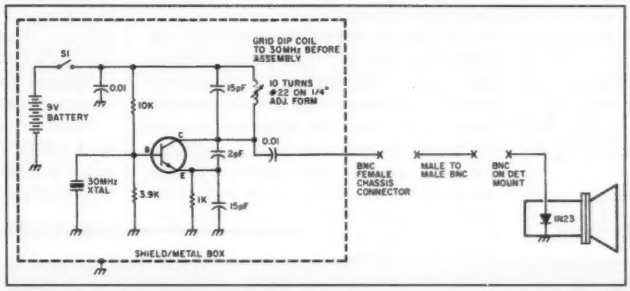

Figure 1. Schematic of oscillator that produces the RF that drives the 1N23 diode in the wave-guide mounted detector.

The other advantage of the boomerang is that it will tell you quickly when your transmitting Gunn oscillator is putting out microwave energy. It does not care what frequency you are on. It will return a CW signal, which tells you that your receiver is operating and gives a quick reference for system evaluation.

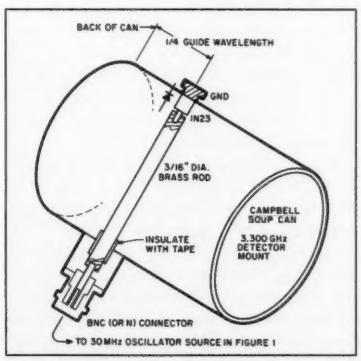

Figure 2. A tin can fitted with a diode as part of a polaplexer for boomerang operation on the amateur 3 GHz band.

Two-Meter Injector

The 2-meter injector is a detector mount that uses a varactor or step-recovery diode as the driven element. We have used an input pad to limit the RF drive from our two-meter HT which, on low power, puts out 200 mW. Pad values were 10 dB to limit the drive to about 10 mW, and 3 dB for 100 mW of drive to the SRD diode. See Figure 3. The diode is rated at 1 watt dissipation. The pad also serves as a DC return for the SRD diode in the detector mount. The best mount possible for the SRD diode would be a commercial unit, as I am not crazy about threading the tip of a somewhat expensive diode. You might want to construct the second version (with the brass tubing on top) with the BNC connector. Either mount will work well, and each has advantages over the over. One offers ease of construction, while the other requires more soldering expertise. Details on both mounts were described in Part 1 of this article. See Photo B, a surplus mount with 3 dB pad, and Photo C, my second version with a BNC connector.

Ed Munn K6OYJ, a member of our San Diego Microwave Group, provided the diode I used. It worked quite well. We knew it was a varactor with a reverse breakdown of 42 volts at 10 micro amps and a junction capacity of 2.31 pF at 6 volts (1 MHz test frequency) and the same case style as a 1N23. The closest commercial diode that I find listed is the Microwave Associates MA-44641D Step Recovery Varactor. I'm currently trying to find one of these devices to test in the mount. Check your local surplus dealers and put that old scrounging effort to work. See Photo B, varactor mount.

I will make available high power Gunn diodes, case style 118 with silver plated brass rivets, for modifying Solfan type cavities operating on 10 GHz. These devices have power outputs from 50 to approximately 100 mW (+15 to +20 dB) for $5 each, postpaid continental US. Some select higher power devices for 6 GHz, 10 GHz, and 18 GHz. Output power varies from cavity to cavity and post mounting arrangements, but all devices are tested prior to shipping for RF. I would be happy to answer any questions regarding this or any other microwave related project. Please contact me at 6345 Badger Lake, San Diego, CA 92119.

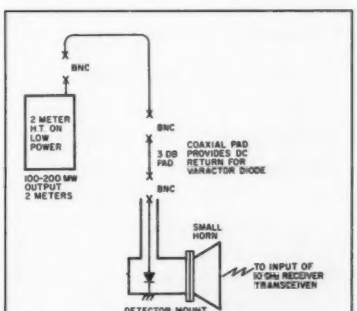

Figure 3. Diagram for the 2-meter injector system. It loads a step-recovery diode (in the detector mount), which generates many harmonics. The 70th harmonic of 146 MHz is 10.220 GHz.

SUPER SIMPLE ATTENUATOR

A construction project for many uses

by W.C. Cloninger, Jr. K3OF

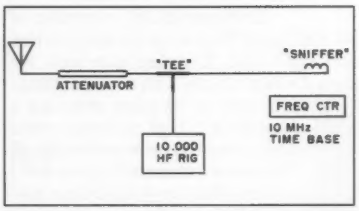

Figure 1. The attenuator balancing two 10 MHz signals into an HF receiver.

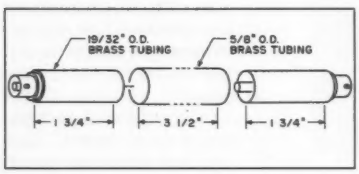

Figure 2. Tube dimensions for the attenuator.

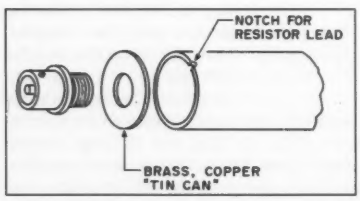

Figure 3. BNC connector attachment details.

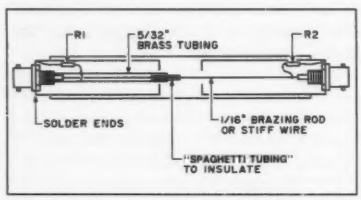

Figure 4. The final assembly of the attenuator.

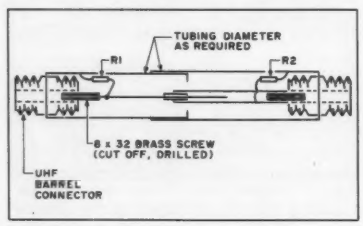

Figure 5. Two-tube attenuator system.

Here is a simple, adjustable, and easy to build attentuator, which has a variety of uses. It uses a simple capacitive coupling with an attempt at a reasonable impedance match. It is a simple one evening project using easy to obtain materials.

Some Practical Uses

Before getting involved in the construction of the attenuator, look at several of its uses. The constructor can think of additional uses to fit his own needs.

I first constructed the attenuator for "rabbit hunting" (DFing 2 meter hidden transmitters). It is a little difficult to get a beam heading when the S-meter on the rig is at full scale all the time. The attenuator provides the answer for adjusting the received signal for a less than full scale reading. With the attenuator I could determine the peak or null depending on the type of antenna I was using. The attenuator is an absolute must for reducing any strong or weak signals when close to a transmitter.

> ***"The attenuator is an absolute must for reducing any strong or weak signals when close to a transmitter."***

In addition to the original use, I found that it has been just the item I needed to use with test equipment. Figure 1 shows how I used it to "balance" two 10 MHz signals into my HF receiver to zero beat my frequency counter. (Hint: If considering to purchase a frequency counter, give strong consideration to the one with a 10 MHz time base that can easily zero beat with WWV on 10 MHz. It is easily worth a few dollars more to be able to check and adjust the counter time base by hand.)

Other routine uses are to limit input to my frequency counter and my FM deviation meter. I use a "gimmick" in my dummy load to pick up RF and causing the level to be significant at high power levels. I quite often feed this RF directly into the test equipment. It ensures that the signals do not overload the input of the equipment, and more importantly do not damage the equipment. This attenuator is for use with low level RF and receive type signals. It is not to be used with a transmitter since R1 and R2 are ½-watt resistors.

Construction

Construction is very simple, and the only items I did not have in my junk box were the pieces of brass tubing. The local hobby shop had an assortment of brass tubing from about 1/16″ to 1″. It comes in so many different sizes that each larger size will just slide over the next smaller size. Just pick the size that suits the need of the type of connector being used. Dimensions are given in Figure 2 for the attenuator I built when using BNC connectors. There is nothing critical about dimensions. I used a three tube system, but the constructor can just as easily use the two tube system seen in Figure 5.

I made the end plates from a piece of tin can stock shown in Figure 3. I drilled the appropriate hole for the BNC connector, installed the connector and tightened the nut. It is important to tighten the nut before assembly, since access to the nut is impossible after soldering the end plate to the tubing. Now solder the solid wire and the small diameter brass tubing to the appropriate connectors. Use care to keep the tubing or wire in good alignment with the axis of the center conductor. Add a 47Ω ½-watt resistor to each center conductor as shown, but leave the other end of the resistor free for soldering during final assembly.

I used 1/16″ brazing rod for the center wire. I find brazing rod very useful for a lot of projects around the shack. I inserted a small piece of spaghetti insulation into the 5/32″ tubing. It might be just as easy to place heat-shrink tubing over the 1/16″ rod.

Now assemble everything as shown in Figure 4. Place the large brass tubing sections in their closed position, and the two connector end sections into their final position. This assembly, before soldering the end plates, puts everything into alignment. Solder the end plates and the ends of the 47Ω resistors to the large tubing. File or grind any excess metal from the end plates. This completes construction.

This is a handy addition to any workbench or shack. Enjoy! ■

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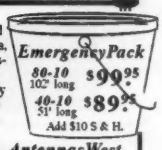

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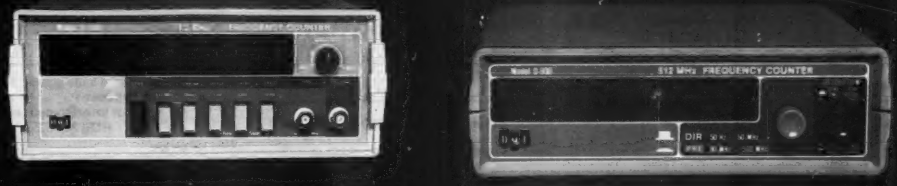

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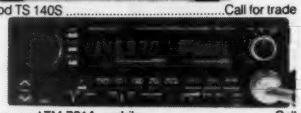

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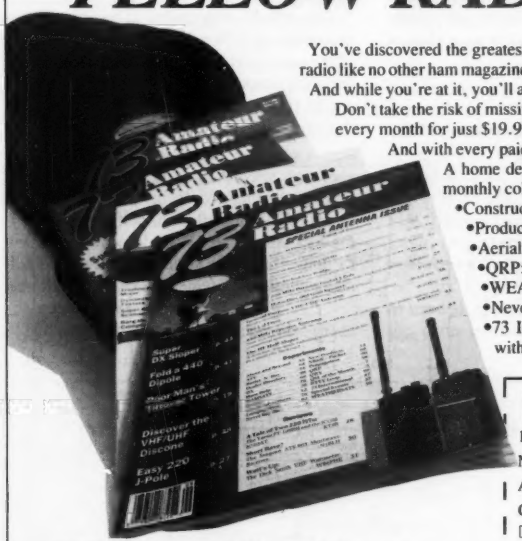

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THE 220 MHz ALL-MODE TRANSVERTER

Designed for the dedicated home-brewer.

by Robert E. Bloom W6YUY

Because of the increased interest and activity in 220 MHz single sideband and the positive response to my Two-Meter Transverter project in July 1987 *73* (pps 32-43), I have now designed an improved, 220 MHz version of the transverter. This transverter is capable of FM repeater operation as well as CW and SSB, and it's much more sophisticated than the usual FM transceivers and hand-helds on the market. All frequencies on this unit can be set with direct read-out to the nearest 10 Hz. Of course, DX simplex operation on both FM and SSB is one of its most exciting features.

Like the earlier unit, this is an all-mode transverter specifically designed to interface with the Kenwood TS-940S HF transceiver. It will also work with other full-frequency coverage transceivers equipped with a transverter access plug. The transverter has a CW output of 3-½ watts. I will cover in a later article a 220 MHz DMOS linear amplifier with a power output of 60 watts.

Why Not PC Cards?

The construction of this unit uses point-to-point wiring in a soldered PC-card structure that provides several benefits.

1. A printed circuit board would require foil circuits on both sides, making double-deck construction impossible.
2. Compartmentalizing would require a separate PC board for each stage or section.
3. A PC card would require more space because of restrictions on parts placement. With this type of construction you can use the walls of the compartment as well as the floor for mounting parts.
4. Exact duplication of components is not required.
5. Excellent interstage isolation.
6. More freedom and ease of modification than normal printed circuit board techniques.

Your TS-940 transceiver must be modified, of course, to work with the 220 MHz transverter, because 222 to 225 MHz will be mapped into 22 to 25 MHz and the unmodified transceiver will not transmit outside the ham bands. (Obviously, it is not legal to transmit with the modified Kenwood outside the amateur bands authorized by your class of license.)

Take It Step-by-Step

Realizing the apprehension you may feel when looking at a complex project, I provided, in Figures 5 and 6, drawings of the layout of the major parts. By showing the approximate placement of coils, tuning capacitors, and transistors, I hope to simplify the placement of the rest of the components for you. Since you are building this unit step-by-step, you won't have to place the shields between stages in exactly the locations shown in the drawings. Also, your components may be of different sizes, but the compartments should have enough space in most cases.

THE HOUSING

Case and Module Fabrication

The 220 MHz transverter is a one-piece module with a housing made up of double-sided PC board material. The top of the chassis contains the receiver and oscillator chain; the bottom has the transmitter and control circuitry.

The outside dimensions of the transverter assembly are 8-⅜ x 4-¼ x 2-⅜". The height of the partitions is 1/16" less than the depth of the compartment, so the top and bottom covers fit flush with the side panels. Similarly, the front and back panels are ⅛" wider than

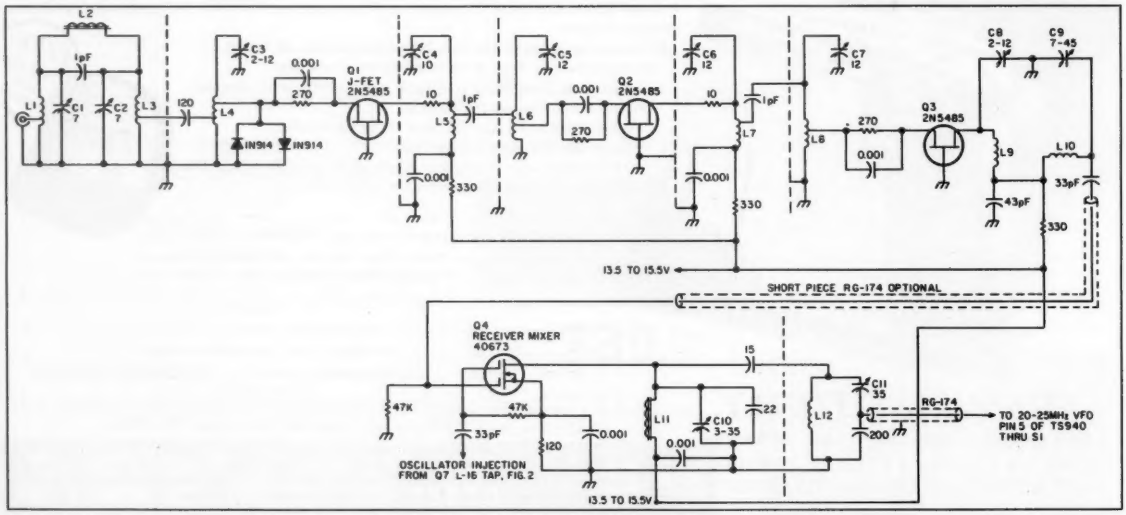

Figure 1. Schematic of the receiver portion of the 222–225 MHz transverter.

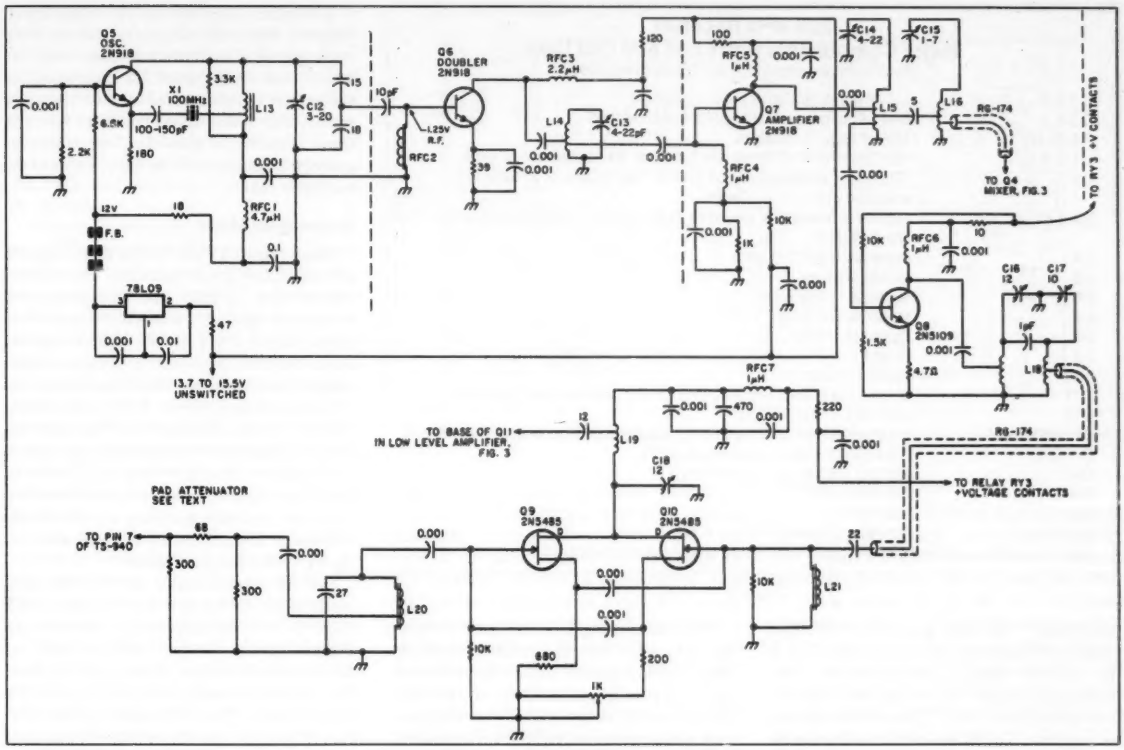

Figure 2. Schematic of crystal oscillator circuit (100 MHz) and doubler.

the main circuit board chassis to allow for the 1/16" side panel thickness.

Draw a pencil line down the middle of each side piece to help in locating the main center board that separates the top from the bottom. Start by tack-soldering just inside each end, making sure that the sides are at exact right angles with the center board. Then tack the end pieces into position. When the box is square, solder the corners and then seam-solder the sides from the inside.

Figures 5 and 6 are parts layout drawings showing the individual compartment sizes, ±1/16" and do not allow for the ±1/16" thickness of the separators. These dimensions are flexible and can be used as an indication of how much room you need and how much space you have left as you go along.

The compartment separators are also made up of double-sided PC card stock and construction is serial: you complete one stage and install a separator before going on to the next stage. This way, you won't be caught either short or long on space. Drill all feedthrough holes in the compartment separators before soldering the separators in—drilling afterwards is difficult!

Single-sided PC stock is used for the terminal mounting pads to which component leads are soldered. If all the PC material you have is double-sided, you can remove the foil from one side by holding the material in a bench vise, heating one side gently with a propane torch, and pulling off the foil with pliers.

Make up a supply of single-sided strips—⅛", 5/32", and ⅜" wide—and snip off pieces as needed with diagonal cutters. Using a single drop of Eastman 910 cement (Crazy Glue), position these pads where needed with long-nose pliers. Four seconds later, you can solder to the pad. Should you decide that the pad is not in exactly the right position, you can remove it by prying with a pocket knife or small sharp screwdriver. Do not re-use a pad, as it will not hold securely the second time.

The unit will operate well without the covers in place. However, when the top cover is removed exposing the receiver's pre-selector stages, the unit will pick up strong signals even if it isn't connected to an antenna. Rather than secure the covers permanently, you can hold them in place with transparent tape for easy access to the circuitry.

Panel Hardware

You can drill the holes in the front and back of the case either before or after the box is

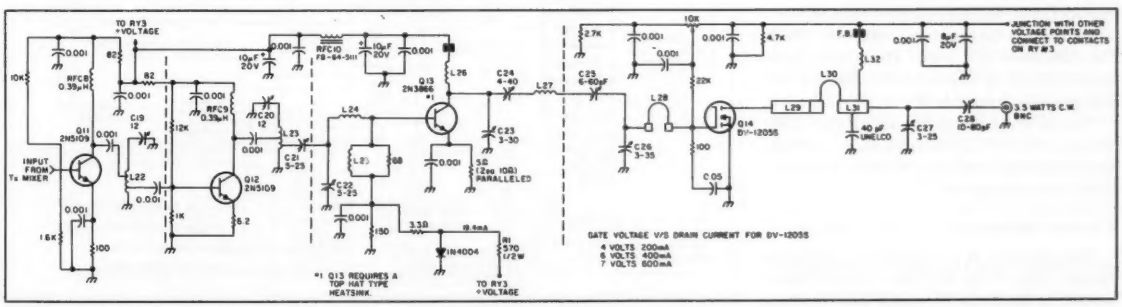

Figure 3. 220 MHz transmitter low-level amplifier section.

220 MHz Receiver
Major Components Parts List and Coil Data

(Small resistors, capacitors, and inductors not listed)

C-1, C-2	1–7-pF quality miniature piston capacitors
C-3–C-8	2–12 pF Johnson air variable, PC board ceramic
C-9–C-12	3–35 pF ceramic variables
L-1, L-3	Four turns #16 or 18 tinned wire ¼" inside dia., tapped at 1-¼ turns
L-2	19 turns #20 enameled wire on T-50-12 Amidon core, or 21 turns #24 enameled wire on T-37-12 core
L-4–L-9	4 turns #16 tinned wire, wound on #3 drill (0.212"), all four turns spaced 1-½ wire diameters
L-4	tapped at ¾ and 2-½ turns
L-5	tapped at 2 turns
L-6	tapped at ½ and 3 turns
L-7	tapped at 2-½ turns
L-8	tapped at 3 turns
L-9	no taps
L-10	tapped at 3 turns
L-11	22 turns #28 enamel wire on T-25-6 Amidon powdered-iron toroid core
L-12	Same as L-11 but 19 turns
FB Ferrite Beads	101 size of 43, 64, or 75 material; typical Amidon designation, FB-43-101
Q-1–Q-3	2N5485 or 2N5486 (or equivalent) JFETs
Q-4	40673 or 40673A dual gate MOSFET
Q-5–Q-7	2N918 transistor
Q-8	2N5109
Q-9, Q-10	2N5485 or 2N5486 JFETs

Note: All resistors used in the project are ¼ watt ±10% unless stated otherwise.

Table 1.

assembled. The front panel has two BNC bulkhead connectors on the left edge. One is for received signal in and the other is for transmitted signal out, to interface with the power amplifier. An LED shows when power is applied. The three-pole, double-throw miniature switch and eight-pin male mike bulkhead connector complete the panel. The eight-pin connector couples to the TS-940 interfacing cable. The back panel has a four-section miniature barrier strip for source power to the transverter.

CIRCUIT SECTIONS

Receiver Converter

The receiver portion (shown in Figure 1) has three JFET pre-amplifier stages. Dual gate MOSFETs would provide twice the gain, but much less stability and more noise. The bandwidth of these stages is set by positioning the taps on the RF coils (see the Coil Tapping sidebar). A tap placed closest to the top or high impedance point of the coil provides heavy loading, driving the Q of the stage down for a broader bandwidth. The lower the tap point, the higher the circuit Q, and the more selectivity and gain per stage.

Because the transverter is not retuned during operation, the bandwidth or bandpass discussed here is the total bandwidth over which the transverter will work. The actual operational selectivity is provided by the TS-940 being used as a tunable IF.

Each of these stages provides about 12 dB of gain, with 15 dB the maximum. A bandpass and image frequency rejection filter precedes the preamplifier.

Crystal Oscillator

The oscillator is a variation of the Butler design—one of my favorites. The oscillator circuit is particularly suited for overtone crystals, and, with light loading, is very stable.

The oscillator coil L-13 in Figure 2 is tuned by a network of fixed and variable capacitors. The variable capacitor is tuned for resonance, while the parallel and series divider provides the required drive level to the frequency doubler. (With the proper selection of capacitors, we can retain the correct parallel [product-over-the-sum] capacity, and we can select a correct drive level for the frequency doubler. In addition, we reduce loading on the oscillator output circuit.)

The selection of coil tap on L-13 provides the oscillator feedback voltage required for stable oscillation. The 100 MHz crystal oscillator feeds the doubler, which retains about 66% of the oscillator's energy. Using a 100-MHz crystal and a doubler, the 200 MHz is much cleaner than it would be if you used a tripler. A simple doubler circuit provides the required 200-MHz output frequency, while the amplifiers with double-tuned bandpass circuits clean up the frequency from the output of the doubler stage.

To further clean up the 200 MHz signal before it enters the receiver mixer, we add a third amplifier and bandpass filter stage. A fourth, and similar amplifier stage provides the heavier signal required for the transmitter mixer. The double-tuned bandpass filters in these amplifier stages clean up whatever garbage is generated in the early stages of the oscillator chain.

Transmitter Mixer

Much research went into the determination of transmitter mixer circuitry. Both active and passive, double- and single-balanced types were studied. I selected the single-balanced, active JFET circuit after comparing major characteristics such as dynamic range, suppression of intermodulation products, and cross-modulation effects. FETs were selected over bipolar transistors for their inherent transfer characteristics approaching a square law response, thus providing a reduction of third overtone products. Harmonic distortion and cross-modulation effects are third-order dependent, and are greatly reduced when using FETs in a balanced mixer.

For RF amplification, use the following guide to set up the DV-1205S V-MOSFET stage Q-14 in the main transverter unit (see Figure 3). The level of drain current and ultimate power output of the stage is a function of gate voltage controlled by the 10k potentiometer. Four volts gives a drain current of 200 mA, six volts yields 400 mA, and seven volts sets up 600 mA. If you don't get an increase in power output with increased drain current, you don't have enough drive power and it isn't economical to increase the drain current further. Since this project has three MOSFET linear amplifier stages, set the output levels for only what you require. On the other hand, if the drive is much greater than you need, don't worry about blowing the FETs, since you cannot hurt them by overdriving.

Control Circuit Function

Refer to Figure 4 and Table 4. Plugging the DIN plug into the TS-940 mechanically switches the TS-940's input circuitry to desensitize it to HF signals. At the same time,

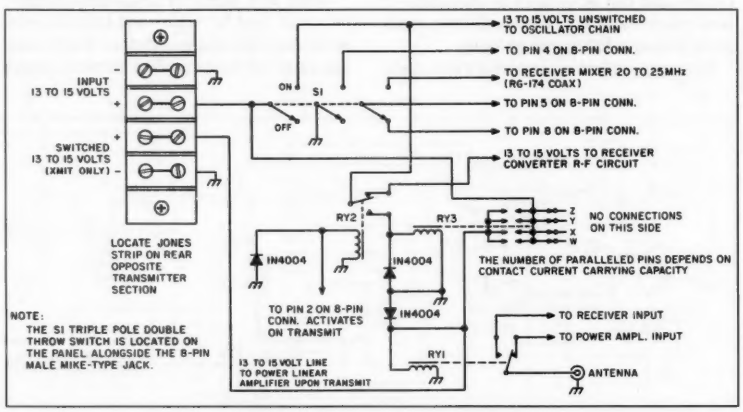
INPUT 13 TO 15 VOLTS
SWITCHED 13 TO 15 VOLTS (XMIT ONLY)
LOCATE JONES STRIP ON REAR OPPOSITE TRANSMITTER SECTION
NOTE: THE S1 TRIPLE POLE DOUBLE THROW SWITCH IS LOCATED ON THE PANEL ALONGSIDE THE 8-PIN MALE MIKE-TYPE JACK.
ON
S1
OFF
13 TO 15 VOLTS UNSWITCHED TO OSCILLATOR CHAIN
TO PIN 4 ON 8-PIN CONN.
TO RECEIVER MIXER 20 TO 25 MHz (RG-174 COAX)
TO PIN 5 ON 8-PIN CONN.
TO PIN 8 ON 8-PIN CONN.
13 TO 15 VOLTS TO RECEIVER CONVERTER R-F CIRCUIT
RY2
RY3
Z
Y
X
W
NO CONNECTIONS ON THIS SIDE
IN4004
IN4004
IN4004
THE NUMBER OF PARALLELED PINS DEPENDS ON CONTACT CURRENT CARRYING CAPACITY
TO PIN 2 ON 8-PIN CONN. ACTIVATES ON TRANSMIT
TO RECEIVER INPUT
TO POWER AMPL. INPUT
RY1
13 TO 15 VOLT LINE TO POWER LINEAR AMPLIFIER UPON TRANSMIT
ANTENNA

Figure 4. Control circuit wiring diagram.

With SW-1 ON, the first set of switch contacts applies 13 to 15 volts from the input terminals of the barrier strip to the RY-2 armature contact, providing voltage to all of the receiver circuitry and the oscillator chain (except for the Q-9 stage). The second set of switch contacts grounds the coil of RY-3 in the TS-940S, closing the relay, disconnecting the VFO, and disabling other LF circuits in the TS-940.

When you press the microphone push-to-talk (PTT) switch, the Kenwood puts 12 volts at 50 mA on pin 2 of the 940's DIN plug, activating the transverter RY-2, which in turn removes the supply voltage from the receiver and activates transverter RY-3. RY-3 then applies supply voltage to the Q-9 output stage along with all the source voltages to the transmitter section. In addition, plus voltage is supplied to the barrier strip for the outboard linear amplifier and antenna relay #1. Releasing the PTT switches the transmitter and its associated circuitry off, and returns the unit to receive.

Toggling SW-1 to OFF, the arm of the third pole connects pin 5 with pin 8 on the 940's transverter plug. This allows the TS-940 to operate in the normal manner on HF, even though the transverter is still connected.

When purchasing the RY-2 control relay, keep in mind that its 12-volt actuating voltage comes from the TS-940, and the maximum current available is 50 mA. Many 12-volt relays require more than twice this level. The unit you select should have a field coil resistance of *no less than* 250 ohms.

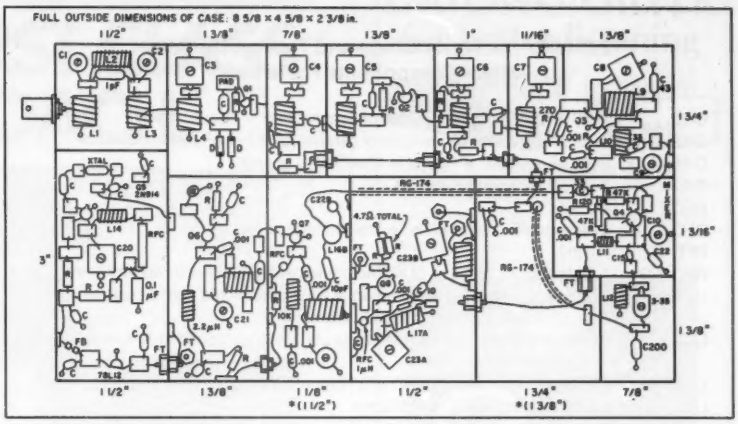

Figure 5. Major parts positioning (approximate dimensions) for the receiver and oscillator, top section.

TS-940

TS-940 Interface Cable

A 30" cable connects the transverter to the XVTR plug on the back of the TS-940 (see Table 4). Get the eight-pin DIN plug from Kenwood. Don't try to buy this plug elsewhere, as the plug you get probably won't fit the Kenwood's jack. I purchased three from other sources; no two were the same and none of them fit the TS-940. Just connect like numbers on the DIN plug and the eight-pin mike jack. You'll need three runs of small-diameter coax for pins 5, 7, and 8. Use cable with a Teflon dielectric. Don't use RG-174—the dielectric can melt during soldering, causing a short. Pins 1 and 3 are shield ground. Use a good grade of #20-stranded between the two number 2 pins and the two number 4 pins. Pin 6, ALC on the transceiver, is not used. Pin 6, by the way, is the center pin on the DIN plug, while pin 8 is the center pin on the eight-pin mike connector...

Recall that the very act of inserting the DIN plug into the 940 transverter jack disconnects the HF front end in the 940 to avoid leakthrough of HF signals at what is now the first intermediate frequency. In order to use the Kenwood on HF when the transverter is plugged in, a switch in the transverter connects pins 5 and 8 when the transverter is turned off.

Pin 2 provides 12 volts (at a maximum of 50 mA) during transmit for use as PTT in the transverter. A ground on pin 4 by the transverter disables the TS-940's power amplifier. RF/IF input signals between 22 and 25 MHz come from the transverter to the Kenwood on pin 5 with the outgoing (transmitted) signal at a level of about 100 mW on pin 7. Pin 8 is the TS-940's HF input, which must be connected to restore HF operation.

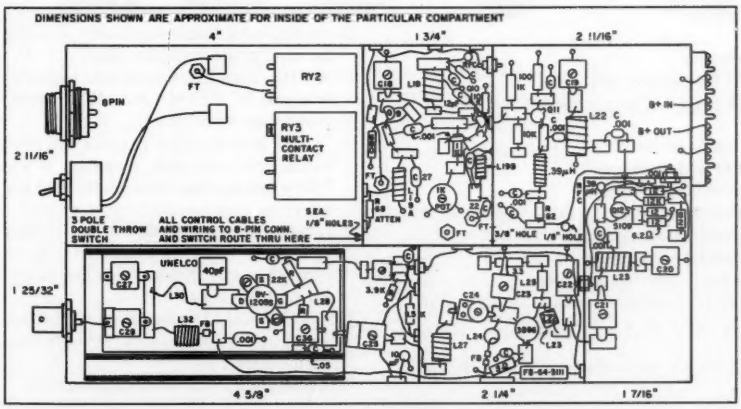

Figure 6. Major parts positioning for the transmitter and control, bottom side.

TS-940 Modification

To enable the TS-940 to transmit outside the regular ham bands, cut diode D-130 from the circuit. The transceiver will then transmit anywhere between 1500 kHz and 30 MHz. D-130 is located on the unit "B" PC board just behind the LCD display on the panel. (The diode is identified, as are other components, by screening on the PC board.) I removed the five screws on the module containing the board, but the board is still difficult to access and requires patience. A letter from a New Zealand reader of my previous transverter article suggested loosening the panel to the point where it could be tilted forward, exposing the diode, which is then cut free at one end using a diagonal cutter. The VFO frequency for the tunable IF is 22 to 25 MHz. Thus, the TS-940 dial read-out for a frequency of 223.259.81 MHz will be 23.259.81. The first digit "2" is understood, as all of the frequencies are in the 200-MHz range. For example, 22 on the dial indicates 222 MHz, plus all of the subsequent digits. Note that the frequency is read to the closest 10 Hz, so be sure to zero-beat both the TS-940 crystal and the transverter oscillator to WWV.

Construction Aids

Figure 4 shows the control circuit wiring diagram. Schematics for the receiver and transmitter sections, as well as separate major parts list for each section, are furnished. See Tables 1-3. In addition, see the photographs of both top and bottom views of the transverter.

If you follow the coil winding data, you should not have a problem attaining resonance in any of the stages. Coil construction has been further simplified by using toroidal cores. These are readily available in small quantities at under a dollar each from *Amidon Associates, Inc., 12033 Otsego St., North Hollywood CA 91607.* Tell them you saw the cores mentioned in *73 Magazine.*

Potpourri of Technical Construction Notes

In the bandpass filter in the Q-4 transistor stages, L-10 is lightly coupled and at right

220 MHz Oscillator Chain and Transmitter Mixer Major Components Parts List

C-12	3–20 pF miniature air variable or ceramic disk
C-13, C-14	4–22 pF miniature air variable or ceramic C-151–7 pF piston capacitor
C-16, C-18	2–12 pF Johnson air variable used on PC boards
C-17	2–10 pF Johnson similar to C-16
RFC-1	4.7 µH
RFC-2	3 turns on FB-64-5111 6-hole Amidon ferrite core
RFC-3	2.2 µH
RFC-4–7	1.0 µH approx. 25 turns of #28 enameled wire on a ½-watt resistor form
L-13	7 turns #20 enameled wire tapped at 2 turns from cold end, wound on a T-37-12 powdered-iron Amidon toroid core
L-14	4 turns #18 bus wire 3/16″ inside dia., 9/16″ long, tapped at ¾ turn at 3-¾″ from cold end
L-15	5 turns #18 bus wire 3/16″ ID x ½″ tapped at 1-½, 2½ at 4 turns
L-16	6 turns #20 tapped at ¾ at 5 turns
L-17	5 turns #18 bus wire ¼″ x ½″ tapped at 1-½ turns
L-18	4 turns #18 bus wire ¼″ x ½″ tapped at 1-½ turns
L-19	4 turns #16 bus wire wound on #3 drill (0.212″) tapped at 1-½ turns from cold end

Table 2.

angles to the center of L-9. Do not place L-9 and L-10 closer than ¼″ to each other. The bandpass filters of both the Q-7 and Q-8 circuits also have their coils at right angles for minimum coupling. Here, the coupled coils should be placed at least 1″ apart, so that coupling is primarily through the 5 pF and 1 pF capacitors, respectively. Even at this distance, there's some mutual coupling.

There are a number of places where RF chokes are called out. Most of these are wound using ¼- and ½-watt resistors as the coil forms. The following should assist in coil winding.

A reactance vs. frequency, capacity, and inductance chart or a cardboard reactance slide rule are great tools. A grid dip meter is another. You'll need several 0.39-µH chokes. A 0.39-µH choke will resonate at 50 MHz when shunted with a 27-pF capacitor. By using this point, you can locate other capacitance and inductance values on the scales. You can make the 0.39-µH unit with a ½-watt resistor of 3000 ohms or more. Make notches at the ends of the resistor with a jeweler's file to prevent the wire from slipping. Close-wind 25 turns of #28-gage enameled wire on the resistor, and grid-dip with a capacitor to check the value.

You'll also need some 1.0-µH chokes.

220 MHz Unit RF Chain Major Parts List for Transmitter

C-19, C-20	2–12 pF Johnson air variable for PC boards
C-21–C-23	5–25 pF Arco 400 series compression
C-26, C-27	5–35 pF Arco 400 series compression
C-24	4–40 pF Arco 400 series compression
C-25	6–60 pF Arco 400 series compression
C-28	10–80 pF Arco 400 series compression
Q-11, Q-12	2N5109 transistor
Q-13	2N3866 transistor with top-hat heat sink
Q-14	M/A COM PHI RF power MOSFET DV-1205S 5 watt
L-22	5 turns #18 bus wire, wound on #3 drill, 9/16″ long, tapped at ½ and 1-½ from cold end
L-23	Same as L-22, tapped at ½ and 1-⅝ turns
L-24	3 turns #18, 0.3″ diameter spaced 2 wire diameters
L-25	7 turns #28 wound on a 62 or 68 ohm ¼ watt resistor
L-26	5 turns #18 bus wire on #3 drill, 9/16″ long
L-27	3 turns #18 bus wire on #3 drill, spaced 3 wire diameters L-28, L-30¾″ of #16 tinned bus wire bent into a hairpin ⅓″ diameter
L-32	8 turns #22 Teflon covered wire, close wound ¼″ diameter
L-29	¼″ wide strip of single-sided PC board material, epoxied as though it were another pad 0.66″ long
L-31	As in L-29, but ½″ long
R-1	Part of Q-18, 2N3866 bias circuit 570 ohm, made of a 1k ohm and 1.3k ohm ¼-watt resistors paralleled

Table 3.

These should resonate at 16 MHz when shunted with 100 pF. Fill a ½-watt resistor with #31 wire. Wire size is important. Note that 25 turns of #28 wire on a ½-watt form also makes the same 1-µH value. As an additional aid, note that a value of 0.18 µH resonates at 70 MHz when shunted with 27 pF.

Refer to the dimensions of stage components. Notice that on the receiver side, a compartment of 1¾″ has only a few components. This compartment originally had a redundant stage. Notice also that the Q-7 stage is a bit crowded. If you expand the width of this compartment, you will be able to move the Q-8 stage down.

On the front panel, the BNC connectors are located 1″ in from the case edge and are 1-¼″ on center from one another. The eight-pin mike-type connector is ⅜″ in from the opposite edge of the case. Positioning of these parts is not critical.

I had no problem laying out the complicated transmitter section. If you need more width, the Q-12 adjacent stage has plenty of room and can be moved further to the right.

A number of relatively long conductor and RG-174 (⅛″ coaxial cable) runs enter and leave compartments that are not adjacent, but opposing. Also, some of the feedthrough terminals are *not* bypass capacitor feedthroughs. These also come out on the opposite side of the box (top or bottom). Carefully check to make sure that there is nothing in the way on the opposite side, and that the feedthrough enters the proper stage on that side. The component layout drawings represent relative positioning. In order to keep the drawing clear, only major components have been drawn in.

Caution: The Q-13 2N3866 transistor requires a top-hat heat sink. The case of this transistor is connected to the collector and it takes unkindly to being shorted, even for an instant. *Make sure the top hat clears other parts when positioning this transistor on the board.*

Test Equipment

In order to test and align your transverter, you will need the following test equipment.

1. A stable signal generator or calibrated oscillator and adjustable 50 ohm attenuator covering the appropriate RF range.
2. An electronic frequency counter covering the appropriate frequency range.
3. A VHF range RF vacuum tube voltmeter or a good DC VTVM with UHF RF probe. (Solid state is fine, too.)
4. A VHF grid dip meter to check coil resonance. (Not absolutely necessary if you follow coil winding data closely, but a real aid.)
5. A capacity bridge to confirm small values of capacity marked, and to set a given capacity in a test circuit. (See *Ham Radio*, March 1980, page 54.)
6. A Bird Model 43 wattmeter or other power measuring device, and a 50 ohm load (termination).
7. A multi-range Volt-Ohm milliammeter.

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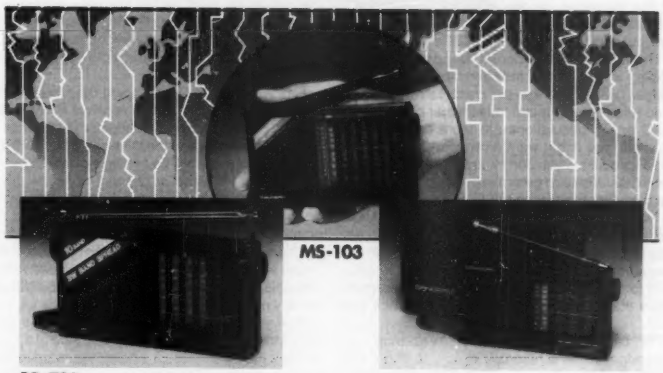

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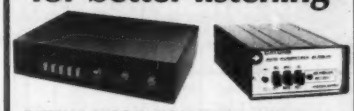

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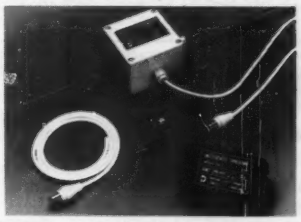

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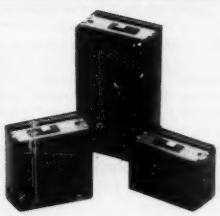

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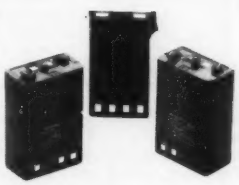

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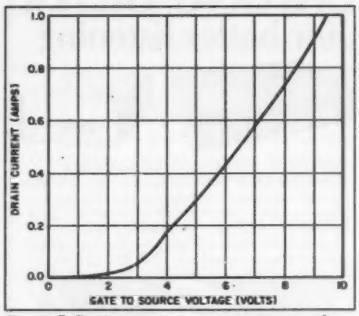

Figure 7. Drain current vs. gate-to-source voltage for the DV-1205S, located in the low-level amp section.

Where To Find Components at Reasonable Prices

In this project you will use quantities of miniature plate capacitors, various sizes of compression capacitors, disc ceramic variables and fixed capacitors, and dipped silver micas (dog bone) components. Fixed disc ceramic of 0.001 mF are sprayed around the source voltage lines as bypasses and as both coupling and decoupling circuits. In circuits requiring a degree of stability, use silver mica. Miniature PC board air variables, Johnson 2–12 pF, usually 8 plates total, are used in stable RF circuits. These plates and small, high quality Arco compression type resonate coils.

You will notice lots of tuning capacitors. This adds up to a nice piece of change. Many of the stages in the receiver could be tuned temporarily with a good-quality variable capacitor. Remove the variable carefully so as not to change its setting and measure its value with a capacitance bridge. Now insert a dipped silver-mica of that value in that spot. You can make minor adjustments by compressing or expanding the coils on the toroidal core until resonance is re-established. This is a mildly complex substitution I have seen described in many publications.

All powdered iron and ferrite toroidal cores and baluns are available from Amidon Associates. You can buy the eight-pin DIN plug from Kenwood. Get two. The price ranges from $2 to $2.50 each. I purchased my crystal from *Jan Crystals, 2400 Crystal Drive, Fort Myers, Florida 33906-9989.* Order series resonant 0.001 percent accuracy and enclose a schematic diagram of the oscillator circuit.

MHz Electronics Inc., 3802 N. 27th Ave., Phoenix, AZ 85017 advertises in most ham publications. They also have crystals, transistors, and Unelco noninductive capacitors for the power amplifier. (Send for a catalog.)

Another excellent source for dipped silver mica capacitors, miniature variables, JFETs (15¢), 4067 (25¢) relays, and the small heat sink 2N3866 is *Hosfelt Electronics, Inc., 2610 Sunset Blvd., Steubenville, OH 43952.* The eight-pin mike type plug and jack are available from *Henry Radio* and *Radio Shack.*

Parts are also available at ham swap meets, and I have some items at very reasonable prices. If you have questions or comments, feel free to write me. Enclose an SASE for a response. Upon completing this project (I wish to emphasize taking your time, step by step), the gratification and pride you will feel cannot be expressed on paper.

The 220 power amplifier will appear in a subsequent issue of *73 Magazine.* ■

Coil Tap Mystery

Many hams throw up their hands when it comes to determining the position of a tap on a coil. In many cases, the tap impedance must match that of the following stage. Many hams who understand why the tap is there, think, "That's fine. I can find the proper point if only I know the base impedance of the transistor, or the collector impedance." Mathematical analysis can dissuade almost anyone, but don't despair!—several aids are available.

The impedance Nomogram, found in most handbooks, is practically indispensable for the RF builder. Better still are the cardboard reactance slide rules usually found in technical book stores.

AC or RF calculations are more complex. For example, you might want a capacitor coupling for an RF circuit, but you don't know which size capacitor to use. You can determine the size by relating the capacitor resistance to DC. Here the slide rule or Nomograph comes in handy. Since you know the frequency and you know what would be a tolerable resistance, you can line up the arrow with the frequency and look at the resistance scale adjacent to the capacitance scale. Select the capacitance that is opposite the lowest resistance you want.

We call the AC resistance "reactance" or "impedance." In a resonant circuit, to find a coil impedance, take the value of the capacitance that resonates with this circuit, set the rule to this frequency, and look up the reactance. In a circuit at resonance, the inductive and capacitive reactances are equal.

Often, instead of a tapped coil, you will find a capacitive divider across the coil with the tap at the junction of the two capacitors. The total capacitance of two capacitors in series can be compared to two resistors in parallel (the product of each over the sum of each):

$$C_{ST} = \frac{C_1 \times C_2}{C_1 + C_2}$$

After you get the resultant capacitance, use the slide rule to determine the reactance. You can find the reactance of each of the capacitors individually. See them as two resistors in a series across the coil, and you can visualize the proportions of voltage across the two resistors, i.e., frequency is 25 MHz. Two capacitors of 62 pF in series are across the coil. The reactance of the capacitors at that frequency is 100 ohms. The tap is at the 50 ohm point of the coil. Do not confuse this as the center of the coil, as the inductive reactance across the coil follows a square law rather than a linear law. The reactance of the coil at this point is ¼ of the total.

Coil Tap Loading

This is the meat of coil tapping! You might wish to make some changes in the bandwidth of the receiver section of your transverter. Possibly, if you are interested in only a portion of the band, you may want to sharpen the selectivity.

Occasionally, when tuning a capacitor for resonance, you find a really sharp peak. Another time you might find the capacitor to have a much broader peak. Why is this? You have seen resonant curves in handbooks. If the circuit Q is high, the curve will have steep sides and a narrow bandwidth at some point down the curve, usually the half power point (3 dB). Measure the frequency at the half-power point on the low frequency side of the peak and again on the high-frequency side. The difference in frequency will be the bandwidth. If the coil Q is low, the bandwidth will be greater than if the Q is high.

How do you vary Q by tapping the coil? We can assume that in this circuit (a receiver RF amplifier stage) you don't know the collector impedance or the base impedance of the following stage. But you do know that there will be two taps on the coil, and that the taps will affect its Q and thus its selectivity or bandwidth. Here you have a coil and capacitor which will resonate this circuit at the desired frequency. If the coil wire is sufficiently large, and the coil diameter is ⅓ to ½, the length of the coil, the circuit should have a high Q called "unloaded Q." The selectivity will be high and the bandwidth will be very narrow.

Now you have to get this combination into the circuit to do some work. Ground one side of the coil to make the low impedance point. You want to feed energy into the coil from the collector of the transistor of that stage. The collector impedance will load the Q of this coil. If the impedance is high, you can connect it to the high end of the coil. The ideal point is where the Q drops to one-half. Though the ideal is not always possible, at any rate the bandwidth will increase. If the collector impedance is relatively low, you might wish to tap down the coil. Choose a point from ¼ to ½ down. Collector impedance of a bipolar transistor is generally higher than the base impedance of the following stage.

Let's say you decide on a point ⅓ down the number of coil turns. Now comes the real loading, getting energy from this tank circuit into the base of the following stage. The base tap will be much closer to the bottom or low impedance point of the coil. Place it ½ turn up from ground. Generally at this point it takes somewhat sophisticated equipment to determine what is truly happening.

A sweep frequency signal generator, a calibrated marker generator, and a spectrum analyzer are used in the design laboratory. But when these are not available, there are other ways to make a satisfactory measurement. An RF vacuum tube voltmeter can really help.

Sending a steady signal into the receiver and using some type of indicator, possibly an S-meter on the transceiver, the capacitor is tuned to resonance. If the tuning is sharp, you know the bandwidth will be limited. Tapping the base further up on the coil will load the coil more heavily, and cut down the selectivity, because the tuning will be broader, and the receiver will cover a wider frequency range. One point: the further down the coil (toward ground) that you place the collector tap, the more stable the circuit; but circuit gain will be reduced. ■

TS-940/Transverter Jack-Pin numbers

8-pin DIN pin number	Function
1	Ground
2	PTT to transverter (12VDC @ 50 mA max.)
3	Ground
4	TS-940 Final Amplifier disable (Ground from transverter)
5	Received (input) signal from transverter
6	ALC from TS-940 (not used here)
7	Transmitted (output) signal to transverter
8	Internal TS-940 HF signal—connect to pin 5 to restore TS-940 HF when transverter off.

Table 4.

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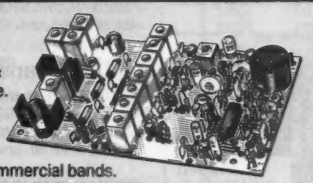

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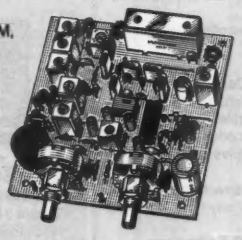

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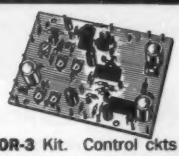

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		50-52	28-30
		50-54	144-148
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MODELS		144-146	28-30
Kit with Case	$59	146-148	28-30
Kit less Case	$39	220-222	28-30
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		222-224	28-30
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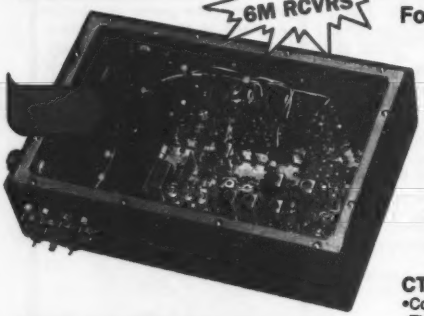

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- Up to 4 different ID channels!
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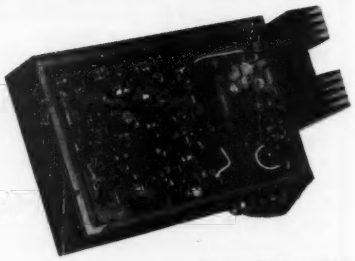


Improved SCT410B Transmitter Assy.

CTC100 Rptr. COR Timer/Control Bd.

- Complete solid state control for rptr. COR,"Hang" Timer, "Time-Out" Timer, TX local & remote Shut-down/Reset, etc.
- Includes inputs & outputs for panel controls & lamps.

COMPLETE SHIELDED RCVR. ASSY.

VHF & UHF Receiver Boards
SCR200A-VHF SCR450A-UHF

- ***Totally Advanced Design!***
- 8 Pole Front End Fltr. + wide dynamic range—Reduces Overload, Spurious Resp. & Intermod.
- Sens. 0.25 µV/12dB SINAD typ.
- Sel. -6dB @ ± 6.5 KHz. -130dB @ ±30KHz. (8 Pole Crystal + 4 Pole Ceramic Fltrs.
- 'S Meter', Discriminator & Deviation Mtr. Outputs!
- Exc. audio quality! Fast squelch! w/0.0005% Crystal. (*"Super Sharp" IF Fltr. also avail.*)
- ***New! 30 KHz B.W. IF Filter for High Speed Packet.***

Power Supply Boards

NEW

- **SCP12** 12 VDC @ 0.3A MAX. OUT.
- **SCP512** 12 VDC @ 1A & 5VDC @ 0.4A out. (1.1A total max. out.)
- **SCP512A** As above, but also w/−12VDC @ 0.1A

SCT110 VHF Xmtr/Exciter Board

- **10 Wts. Output. 100% Duty Cycle!**
- Withstands High VSWR
- True FM for exc. audio quality
- Designed specifically for continuous rptr. service. Very low in "white noise."
- Spurious − 75 dB. Harmonics − 60 dB.
- With .0005% precision grade xtal.
- **BA-30 30 Wt. Amp board & Heat sink,** 3 sec. L.P. filter & rel. pwr. sensor.
- **BA75 75 Wt. unit also available**

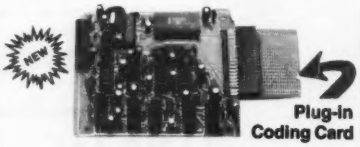
Complete Receiver Assemblies

- Rcvr. Board mounted in shielded housing.
- Completely assembled & tested, w/F.T. caps, SO239 conn.
- As used in the SCR 1000. Ready to drop into your system!
- UHF Rcvr. Assy. Now Available w/Super Sharp FL-4 Helical Resonators. Greatly reduces IM & "out of band" interference!

Receiver Front-End Preselectors

- **FL-6: 6HI Q Resonators with Lo-Noise Transistor Amp (2M or 220 MHz)**
- **FL-4H: 4HI Q Helical Resonators & Lo-Noise Tr. Amp. In shielded housing. (420-470 MHz)**
- **Provides tremendous rejection of "out-of-band" signals w/out the usual loss!** Can often be used instead of large expensive cavity filters.
- Extremely helpful at sites with many nearby transmitters to "filter-out" these out-of-band signals.

Call or Write for Data Sheets



TTC300 TOUCH TONE CONTROLLER

- High performance, Super versatile design. To control any ON/OFF Function at a remote site via DTMF Radio Link.
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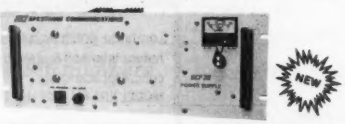


SCP30 HEAVY DUTY 30 AMP RACK MT. POWER SUPPLY

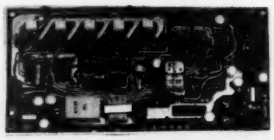
- 13.8 VDC out. 115/230 in, 50/60 Hz.
- 30A @ 70% duty, 25A @ 100% duty.
- Massive 30 lb. Transformer & Heat Sinks.

SCT110 Transmitter Assembly

- ***SCT110 mounted in shielded housing***
- Same as used on SCR 1000 & 2000X
- Completely assmbld. w/F.T. caps, SO239 conn.
- 10, 30, or 75 Wt. unit.

SCT 410B UHF Transmitter Bd. or Assy.

- Similar to SCT110, 10 Wts. nom.
- ***Includes "on board" proportional Xtal Osc./Oven circuitry for very high stability!***
- **BA-40 40W. U HF AMP. BD. & HEAT SINK**



SCAP Autopatch Board

- Provides all basic autopatch functions
- Secure 3 Digit Access; 1 Aux On-Off function, Audio AGC; Built-in timers; etc. Beautiful Audio!
- 0/1 inhibit bd. also available
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- Used w/SCAP board to provide "Reverse Patch" and Land-Line Control of Repeater
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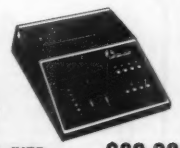

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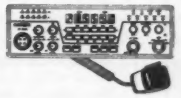

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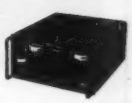

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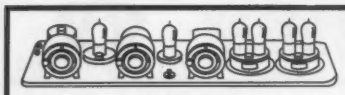

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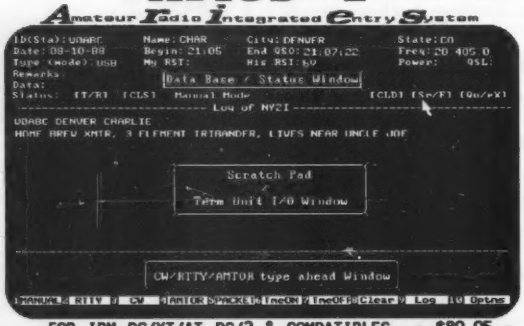

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CHEAP AND DIRTY OSCILLATOR

An audio frequency source for pennies

by Dave Marling VE1VQ

As long as it still works like the experimenter would want it to, simple is always best! Take electronics test equipment. Why build a complicated piece of test gear when a simple one will do the same job? This project costs less, is easier to put together, and less likely to fail.

The audio oscillator in this article serves to illustrate this point. It couldn't get much simpler. Don't forget that the output is far from being a sine or square wave. This project is simple and functional, not laboratory grade.

Circuit Operation

When switch S1 is closed, voltage is connected to the circuit through the diode CR1. Resistors R1 and R2 act as a voltage divider initially holding the base of transistor Q1 (PNP) and the collector of Q2 (NPN) to 6 volts. Capacitor C2 begins to charge through R3. When the voltage across C2 reaches about 6.7 volts, Q1 turns on. This forces the base of Q2 high, turning on Q2. The emitter of the second transistor goes high and since the output is taken from across R5 this also goes high. When Q2 switches on, the output resistor R5 is effectively placed across the PNP base resistor R2 to ground.

Now Q1 base voltage drops from 6 to about 3.6 volts turning on Q1 even harder. C2 starts to discharge through R4 until the voltage across the capacitor is less than the 0.7-volt difference required across the base-emitter junction needed to keep the transistor turned on. Q1 turns off. Q2 turns off. The output goes low. Q1 base voltage returns to 6 volts and the whole thing starts again. Eureka—an oscillator!

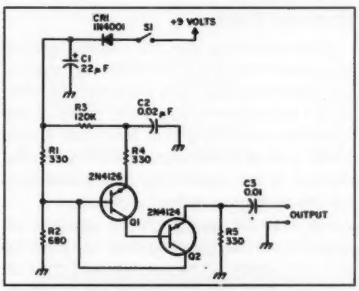

Figure 1. Resistors are ¼ watt.

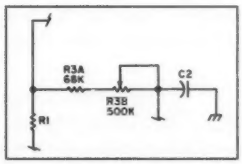

Figure 2. A 500kΩ volume control with a switch can replace S1 and R3.

The transistors are not critical. PNP and NPN types with fiT's of between 200 MHz and 1.1 GHz, plastic low power, metal signal, RF power output, and even a couple of unmarked TO-3's were tried, and all worked fine with very little difference in the frequency.

Two components do affect the frequency. Make R3 smaller and frequency goes up. Make C2 larger and it goes down.

Voltage is another non-critical. Varying the supply voltage from 4.5 to 15 volts changed the frequency somewhat but oscillator start-up occured every time power was switched off and on.

If money is no object, make this thing variable by changing the value of R3 to 68kΩ and adding a 500kΩ potentiometer in series.

As mentioned before, the output has a definite lack of purity. The waveform is actually a spike with a repetition rate of about a thousand hertz. If the experimenter views the output on an oscilloscope he will see all kinds of fuzz and garbage along with the original one kilohertz pulse.

Uses

In the bygone days of ham radio when the experimenter used to fix his own stuff instead of shipping it back to the importer, one of the more indispensable pieces of test gear was the signal injector. Starting at the speaker in a receiver or audio amplifier and working backward along the signal path with the injector, the defective stage was found when the signal disappeared.

All of that garbage from the oscillator actually has some use. While checking the audio stages, the 1000 Hz comes through. Once into the IF and RF sections the fuzz shows its true stuff. The oscillator has usable output out beyond 30 MHz.

I run a burglar alarm business. One of the things that makes the alarms ring in the night is the four-wire cable that runs from each of the many sensors to the alarm panel. Things go fine until a couple dozen of these come through a hole in the back of the panel and the ID tags have fallen off half of them. What to do? Connect the output of the oscillator to two of the four wires in one of the lines at the far end of the run. Back at the panel I check out the unknowns by listening to each in turn with a small battery powered audio amp.

How about a code practice oscillator? Simply connect a key in series between the output capacitor C3 and an audio amp and pound away.

Simple test equipment–simple to build, simple to get working and simple to use with all kinds of uses. That's the best kind!

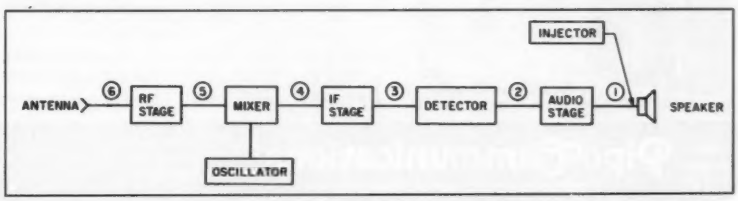

Figure 3. Move the oscillator output from test point 1 through to test point 6. Output from the speaker should increase as the experimenter gets closer to the antenna connector, because of the gain in each stage.

73 Review *by W.S. Gardiner VE6BGL*

AutoSketch and Amateur Radio

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Last April, I bit the bullet and went shopping for a new computer because the old one was, well, *old!* I snuck the new beast through the door with the usual ham stories: it'll be great for word processing, the kids will use it, computer literacy is important, etc. The XYL had probably figured out that the new computer would soon be spewing out RTTY or Morse dit-dah beeps! I gave the old computer to the kids, and they and the neighbors' kids are now happily shooting Martian invaders.

Software was next. The local BBS system had a bunch, and I soon became interested in graphics programs for drawing circuit boards. However, the BBS software couldn't do the job. The commercial stuff could do the job, and had features galore, such as auto-routing, sixteen-layer handling, pretty colors; all explained by manuals as thick as phone books. These programs, however, would put a dent in anybody's wallet.

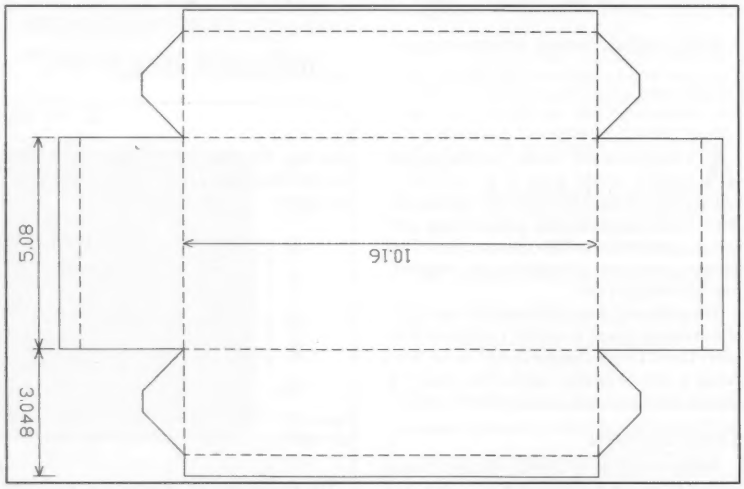

Figure 1. AutoSketch drawing of a chassis.

Little Brother Does the Job

Onto the scene creeps AutoSketch. This is the low-buck brother of AutoCAD the industry standard. AutoCAD costs—well, let's say it's not in my budget, while the list price of AutoSketch is affordable at under $100. It doesn't have all the features of AutoCAD, but does a noble job just the same!

So far, I have used it for the chassis layout, a circuit board design, some furniture arranging, and guy wire calculations. Chassis layout is particularly neat. (See Figure 1.) After you draw a box layout like this one, you can use the AutoSketch STRETCH feature to make the box longer or wider. The dimensions are automatically recalculated! You can also change the size of the box by scaling it up and down when you plot it on the printer. With enough computer paper on hand, it would be possible to lay out a full-size floor plan of the Queen Mary, paste the strips together, and start building from your plans.

Commanding Designs

Circuit board layout is easy with AutoSketch. Until now, I drew all my layouts on 0.1″ graph paper and transferred the finished design onto copper. This meant a lot of time-consuming erasing. AutoSketch has a GRID feature you can set to 0.1″ x 0.1″. A series of dots appear exactly 0.1″ apart. MOVE, COPY, and MIRROR commands make drawing a 14-pin DIP socket a breeze. I drew one pad, used COPY to copy it seven times, then GROUP so the computer would treat it as a unit, and MIRROR to create a finished PART. (See Figure 2.)

Once you have created a PART, you can add it to other drawings, or move, copy, or modify it. You can create a PART library for frequent use. Just pull them up from the menu, put them in position, and keep going! Talk about fast!

AutoSketch for Home and Shack

Remember when the XYL wanted to move the piano? You lugged it all the way over by the begonia planter, and it wouldn't fit! Well, have I got a tool for you. First, measure the room and everything in it. Next, use AutoSketch to draw a floor plan, complete with the objects in the room. You can move them around on the screen first!

For example, you might be deciding on where to put the operating desk and chair for your new shack. Draw the desk and chair on the floor plan, along with all the windows, doors, closets, etc. Then you can MOVE the

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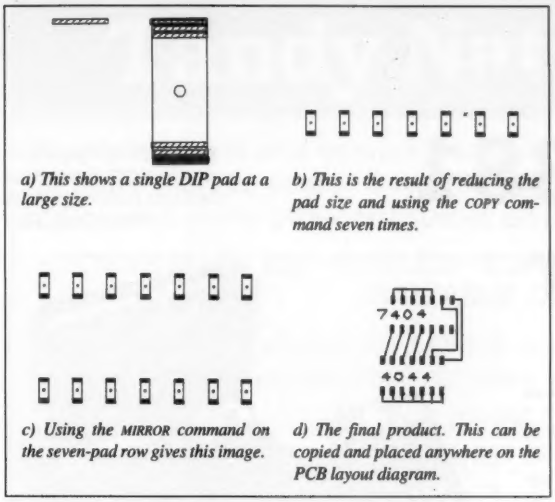

a) This shows a single DIP pad at a large size.

b) This is the result of reducing the pad size and using the COPY command seven times.

c) Using the MIRROR command on the seven-pad row gives this image.

d) The final product. This can be copied and placed anywhere on the PCB layout diagram.

Figure 2. Using AutoSketch to draw a 14-pin DIP socket for PC board layout.

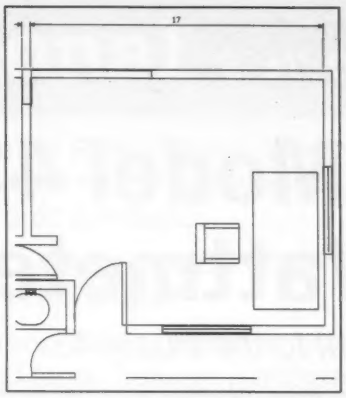

Figure 3. Room layout. AutoSketch can reposition components in the room, such as the desk and chair (lower right).

furniture around on the computer screen with ease. ROTATE lets you turn the chair or desk around to any angle, and MEASURE tells you the distance between two specified points. The ANGLE command is, of course, for angles, and AREA/PERIMETER figures out how much carpet you'll need for your dream shack!

How about guy wires for the tower outside? Again, draw a plan, move the lines around on the screen until they look OK, then use the MEASURE/ANGLE feature to do the calculations. Simple! If you make a mistake, AutoSketch has an UNDO command to fix up the blunders.

The Computer and Printer

A couple of hints: Leave about 100K workspace on your disk to allow the program to store data. If the program suddenly stops printing, the disk is probably full. My copy of AutoSketch has a **read-me** file with instructions for using dot matrix printers, which I should have read first!

You can print big drawings in sections and tape them together. Remember that a box of computer paper is 8-1/2" wide by several hundred feet long. You could draw a full-size wall section of the new house!

To use AutoSketch you will need an IBM compatible computer (512K minimum) with two 5¼" disk drives, and a Hercules, EGA or CGA monitor. I recommend a mouse, but you may use keyboard control. You'll also need a plotter or dot-matrix printer. I use an Epson FX86e. The program is very fussy about what it talks to, and if you aren't sure that your printer is compatible, take it with you to the computer store and try it out before buying.

A final word to my drafting teacher way back in Grade 10, who never liked my arrowheads, who said I never could center a drawing, who despised my lettering. . . Hah!

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73 Review *by Larry R. Antonuk WB9RRT*

Bird Model 4381 RF Wattmeter

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Anyone who has worked his way up through the two-way radio business is intimately familiar with the Bird Model 43 Thruline® Wattmeter. The "Bird" is found next to every toolbox, on every bench, in permanent installations, and anywhere where there's RF. Have lunch with a few old-timers in the land mobile industry, and you're bound to hear stories about the time "the Bird fell from the seventy-foot mark on the tower and survived," or how "when I started out in this business, I had nothing but a box of fuses, a tube caddy, and a Bird." Tough, portable, and accurate . . . "take my wife, take my car, but keep your hands off my Thruline" . . . the Bird would never let you down.

New Bird Model 4381

Progress, of course, did not stop with wattmeters. The Bird Model 4381 Thruline wattmeter is one of the latest high-tech additions to the Bird line; the new kid on the block. Boasting a dazzling array of bells and whistles, the 4381 is quite a contender. (It needs to be, considering how firmly entrenched the incumbent is!)

The Model 4381 is the next logical step in the Bird line. It makes use of a similar 50Ω line section, with the same "Quick-Change" connectors, and the same power sensing elements. In a move totally contrary to industry trends, Bird designed a new product that uses the same "slugs" that we've been using in the Model 43 for years. This means that the 4381 can make use of existing inventories of elements, which keeps the cost lower and ensures compatibility with all the other Birds (and Bird clones) in the shop.

The 4381 uses two "slugs" at once—one at a given power level to sense forward power, and a second at one-tenth of the power level of the first to sense reflected power. The ten-to-one ratio provides higher resolution when sensing reflected power, and allows the unit to provide instantaneous SWR readings, or forward or reverse power, at the touch of a button. If the convenience of one-touch readings is not necessary, it's perfectly OK to use only one element, and manually reverse it to read reflected power.

Past the RF Sensor

Once past the RF-sensing portion, all similarities cease. The 4381 is housed in a slant-front table-top case, the two elements fit near the top, the digital read-out is in the middle, and the multi-function keypad is near the bottom.

The keypad selects the current operating mode of the device. Hit the FWD CW button, and you're reading the continuous wave power going in the forward direction—forward being the direction that the arrow on the element in the forward socket is pointing. All in all, the unit will read CW or PEP power in watts, milliwatts, or kilowatts from 2.5 to 1000 units in the forward direction, and 0.25 to 100 units in the reverse direction. SWR can be directly read from 1.00 to 99.99, modulation percentage from 0.0 to 99.9, and return loss over the range of 0 to 36.1 dB. For convenience, you can display forward and reflected power as dBm. As a bonus, the 4381 provides two types of useful over-range features.

To begin with, you can read each element up to 120% of its stated range. In other words, the 100 watt slug can now read up to 120 watts, and with higher accuracy, than switching to the next higher element and reading it on the low end of the scale. Furthermore, when used with the dBm mode, sensing elements can be over-ranged by 6 dB (or 400%). This means that you can actually measure up to 400 watts with the 100 watt slug if you're willing to convert from dBm to watts yourself!

The digital read-out will probably be seen as both a blessing and a curse. On the one hand, if the radio is supposed to put out fifty watts, there's no question that 49.8 is pretty close, but it's not fifty watts regardless of how cross-eyed you look at the display. On the other hand, some techs might spend the whole afternoon getting a radio from 50.0 to 50.2 watts—yes, it is higher, but so what? The bottom line concerns the actual accuracy of the unit.

Accuracy

As we should all know by now, accuracy is a function of the sensing device, and not simply the number of decimal places in the display. In this case, since the elements are the same as those on the good ol' Bird, the power accuracy is the same as the good ol' Bird: +/−5% full scale. (Using the two-element, ten-to-one ratio system, the reflected element, being closer to the value of the reflected power, will provide higher resolution and more accurate SWR readings than would be obtained by simply reversing the high-power element to read reflected power.) The display uses a "greater than/less than" symbol in place of the last digit to indicate increasing or decreasing levels. Used in conjunction with a MIN/MAX level memory, the "delta" function makes transmitter tuning a snap. (A snap, perhaps, but still not quite as comforting as watching that needle swing back and forth . . .)

The 4381 runs on NiCd batteries. One charge is good for about eight hours. This makes it portable, of course, but the unit is obviously meant to spend its life sitting on a bench. The digital display is certainly more shock-proof than the Model 43's meter movement. Lacking any sort of a handle, however, the 4381 will probably not find its way up too many seventy-foot towers. The higher price tag will probably ensure that the unit stays in the shack—or at least carefully guarded during Field Day.

Versatile and Compatible

After all the dust has settled, the contest ends in a draw. The 4381 performs many functions not available with the standard line of wattmeters—it measures SWR, peak power, and greater over-range. Due to its capabilities and size, the 4381 will find greater use on the test bench, in a production facility, or in a base station. Due to its portability and lower cost, the 43 (and the 43 series) will continue to be used in the field and in situations where economics play a greater role. Rather than the newcomer ousting the old-timer, Bird has provided us with a competent and experienced father and son team. ■

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The *Regency* RH256B is a sixteen-channel VHF land mobile transceiver designed to cover any frequency between 150 to 162 MHz. Since this radio is synthesized, no expensive crystals are needed to store up to 16 frequencies without battery backup. All radios come with CTCSS tone and scanning capabilities. A monitor and night/day switch is also standard. This transceiver even has a priority function. The RH256 makes an ideal radio for any police or fire department volunteer because of its low cost and high performance. A *60 Watt* VHF 150-162 MHz. version called the **RH606B-T** is available for $429.95. A UHF 15 watt, 16 channel version of this radio called the **RU156B-T** is also available and covers 450-482 MHz. but the cost is $454.95.

★★★ Uniden CB Radios ★★★

The *Uniden* line of Citizens Band Radio transceivers is styled to compliment other mobile audio equipment. Uniden CB radios are so reliable that they have a two year limited warranty. From the feature packed PRO 810E to the 310E handheld, there is no better Citizens Band radio on the market today.

PRO310E-T *Uniden* 40 Ch. Portable/Mobile CB...$83.95
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PRO500D-T *Uniden* 40 Channel CB Mobile $38.95
NINJA-T PRO310E with rechargeable battery pack.$99.95
B10-T 1.2V AA Ni-cad battery for Ninja (set of 10)...$20.95
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PRO540E-T *Uniden* 40 channel CB Mobile.....$97.95
PRO640E-T *Uniden* 40 channel SSB CB Mobile ...$137.95
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Frequency range: 29-54, 118-174, 406-512, 806-956 MHz. Excludes 823.9875-849.0125 and 868.9875-894.0125 MHz.
The *Bearcat* 200XLT sets a new standard for handheld scanners in performance and dependability. This full featured unit has 200 programmable channels with 10 scanning banks and 12 band coverage. If you want a very similar model without the 800 MHz. band and 100 channels, order the **BC 100XLT-T** for only $189.95. Includes antenna, carrying case with belt loop, ni-cad battery pack, AC adapter and earphone. Order your scanner now.

Bearcat® 800XLT-T

List price $549.95/CE price $259.95/SPECIAL
12-Band, 40 Channel • No-crystal scanner Priority control • Search/Scan • AC/DC
Bands: 29-54, 118-174, 406-512, 806-912 MHz.
The Uniden 800XLT receives 40 channels in two banks. Scans 15 channels per second. Size 9¼" x 4½" x 12½." If you do not need the 800 MHz. band, a similar model called the **BC 210XLT-T** is available for $178.95.

Bearcat® 145XL-T

List price $189.95/CE price $94.95/SPECIAL
10-Band, 16 Channel • No-crystal scanner Priority control • Weather search • AC/DC
Bands: 29-54, 136-174, 406-512 MHz.
The *Bearcat* 145XL is a 16 channel, programmable scanner covering ten frequency bands. The unit features a built-in delay function that adds a three second delay on all channels to prevent missed transmissions. A mobile version called the **BC560XLT-T** featuring priority, weather search, channel lockout and more is available for $94.95. CEI's package price includes mobile mounting bracket and mobile power cord.

Regency® Informant™ Scanners

Frequency coverage: 35-54, 136-174, 406-512 MHz.
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Frequency Coverage: 28.0000 MHz. to 29.6999 MHz.
The *President* HR2510 Mobile 10 Meter Transceiver made by Uniden, sets a new standard in amateur radio communications. Fully Featured–The HR2510 has everything that you need. Up to 25 Watt PEP USB/LSB and 25 Watt CW mode. Noise Blanker. PA mode. Digital VFO. Built-in S/RF/MOD/SWR meter. Channel switch on the microphone, and much more! The HR2510 lets you operate AM, FM, USB, LSB or CW. The digitally synthesized frequency control gives you maximum stability and you may choose either pre-programmed 10 KHz. channel steps, or use the built-in VFO for steps down to 100 Hz. There's also RIT (Receiver Incremental Tuning) to give you perfectly tuned signals. With receive scanning, you can scan 50 channels in any one of four band segments to find out where the action is. Order your HR2510 today.

BC760XLT
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SPECIAL!

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B6-T 1.2 V AA Ni-Cad batteries (set of eight).....$17.95
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FBW-T Frequency Directory for Western U.S.A. $14.95
ASD-T Air Scan Directory $14.95
SRF-T Survival Radio Frequency Directory $14.95
TSG-T "Top Secret" Registry of U.S. Govt. Freq. ...$14.95
TTC-T Tune in on telephone calls.....$14.95
CBH-T Big CB Handbook/AM/FM/Freeband.....$14.95
TIC-T Techniques for Intercepting Comm. $14.95
RRF-T Railroad frequency directory $14.95
EEC-T Embassy & Espionage Communications....$14.95
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A60-T Magnet mount mobile scanner antenna.....$35.95
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A500-T 10 & 11 Meter – 500 Watt antenna.....$38.95
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CIRCLE 121 ON READER SERVICE CARD

INEXPENSIVE MARKER GENERATOR

Calibrate and stay in band.

by Ron Wong WB6DFQ

A device capable of generating marker signals at precise intervals throughout the HF spectrum is a handy device to have around the shack. Amateurs can use this simple generator to calibrate receivers and identify band edges. By providing marker signals at precise intervals, the generator helps the radio amateur verify that he is operating within the prescribed band limits of his license.

The circuit shown in Figure 1 is just such a beast. It is capable of generating signals at 1 MHz, 100 kHz, 50 kHz, and 25 kHz intervals. Most of the parts for this project are inexpensive and available at any local Radio Shack store. Beginners can handle the construction of this project with good results.

Circuit Description

The oscillator section uses three sections of a 7400 quad NAND gate integrated circuit. The 1 MHz signal from the oscillator is fed into a 7490 decade counter configured to divide by ten, providing the 100 kHz signal. To obtain the 50 and 25 kHz outputs, the 100 kHz signal is further divided by a 7473 dual J-K flip-flop. The first half of the 7473 divides the 100 kHz signal by two, yielding the 50 kHz signal. The second half of the 7473 again divides by two, giving the 25 kHz signal. S-2 selects the output, a square wave rich in harmonics.

The generator may be powered from any convenient 6 to 12 DC volt source. A 7805 fixed voltage regulator supplies the regulated voltage for the oscillator and the divider chips. The generator described here is powered by a 9-volt transistor radio battery.

Construction

Construction of the generator is not critical. The entire unit is built on a Radio Shack multi-purpose board (276-150). This board has two bus strips at the center, and the PC pattern printed on the board is indexed to accept integrated circuits. The components mount on the board with ample room. Other construction techniques are acceptable, such as Vectorboard and flea clips.

I mounted the Radio Shack board in a small 2½" x 4" x 2½" chassis box, with a small on/off toggle switch (S-1) and a rotary switch (S-2) on the front panel. On the rear panel, I used a binding post (J-1) for the output. Inside the box, I placed a Radio Shack 270-326 battery holder for mounting the battery.

Operation

After you build the generator, you will need to calibrate it. The easiest way to do this is to use a receiver capable of receiving WWV at 5, 10, 15, or 20 MHz.

Tune WWV and couple the output of the generator to the antenna terminal of the receiver. Turn on the generator, set S-2 to the 1 MHz position, and adjust C-1 until it zero-beats with WWV. The marker signal should be very strong. If the 1 MHz signal blocks the receiver, loosen the coupling to the antenna terminal, or go to another marker position. You should hear the marker signals well into the VHF region. ■

Photo A. The finished project. The entire unit is housed in a chassis box purchased at a local flea market.

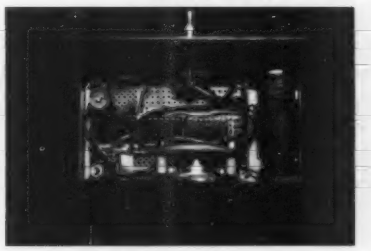

Photo B. The components are mounted on a Radio Shack multi-purpose board (276-150) and wired breadboard style.

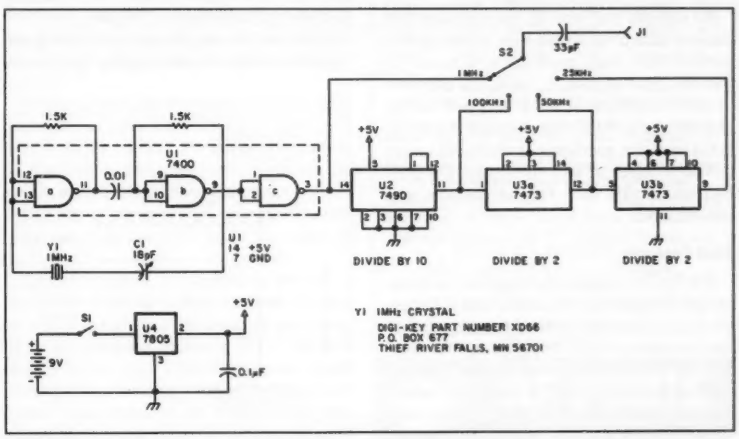

Figure 1. Marker generator schematic.

73 Review *by Fred R. Sharp W8ASF*

VisiTel On-The-Air

Heath Company
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1-800-444-3284
Price Class: $400

A visual phone display you can interface with your transceiver.

Looks like we may finally have affordable SSTV after all, and better yet, something we can share with the XYL (or OM). This is in the form of the Mitsubishi VisiTel visual telephone display system.

The Mitsubishi VisiTel visual telephone display.

Here's Looking At You

The VisiTel is a complete black and white SSTV transceiver designed for telephone service. It comes with a husky line cord power adapter ready to plug in to a modular telephone jack. The compact unit measures 6¾" x 6¾" x 7" and weighs 3½ pounds. It features a built-in 4½" monochrome monitor with miniature fixed-focus vidicon camera. The size of the image is 3¼" x 2½".

Installing and Using VisiTel

This is very simple. Just plug the VisiTel cable into your phone line, and plug your telephone into the VisiTel, and send pictures of the kids to Grandma in Los Angeles or Greece! Of course, Grandma will need a VisiTel to receive your transmission.

To operate the VisiTel, merely slide the camera tube cover to the side, exposing the camera tube. Next, push the SEND button to transmit your picture. It takes 5.5 seconds to send a picture in 90 x 90 pixels at 32 shades of gray. While the pixel and line count is not high, the good gray scale makes up for it. You're better off with more shades of gray and less pixels than vice versa—ask any slow-scanner.

Neat Feature

The VisiTel stores in memory the last three images received as long as the unit is turned on. It kicks the first memorized image out of memory when a fourth image goes into memory. To scroll through the picture memory bank, repeatedly press the VIEW/POSE button. You can send the same picture more than once from the memory. After displaying or sending the stored picture sequence, the VisiTel screen once again displays the user's live image.

The brightness control (up and down) keys enable the user to adjust the contrast in relation to ambient lighting. The keys affect the picture as it is displayed and received.

Interfacing VisiTel and Your Transceiver

The unit interfaces with any VHF or HF transceiver, so you can send and receive the same pictures on the air or record them on audio tape for playback. The other night, for example, Rick WB8RTK and I were sending pictures back and forth on 2 meters.

Since VisiTel uses the same red and green telephone lines for both sending and receiving, you have to couple the transceiver audio through a capacitor. A simple hookup is shown in Figure 1 with the green line as ground.

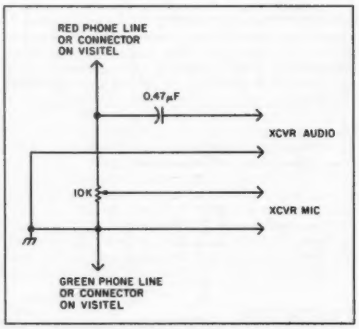

Figure 1. Transceiver audio coupling circuit.

Leave everything as it is for receiving, but for transmitting, you'll have to use your SEND/RECEIVE switch to turn on your carrier before pushing the SEND button. I installed a pot to adjust the output to about 1 volt. Radio aShack's #279-355 quick connect jack is ideal for housing the pot and capacitor. The box contains a modular telephone jack.

The ideal interface would key the VisiTel's push-to-talk line, and change from receive to transmit automatically when you press the SEND button. To sense the tone output of the VisiTel, I first tried using an optocoupler, and then I tried the 567 tone decoder chip, but neither method worked. The tone is present on both receive and transmit, which causes your rig to transmit on receive as well as on transmit. I decided it was impossible to interface without going inside the VisiTel.

Under the Cover

Three self-tapping screws free up the entire cover. Don't worry, no springs will jump out at you and no nuts will drop into some unreachable corner of the chassis. The mother board is easily recognizable and readily accessible, and just two connections are tack-soldered on top of the board. They are shown in Figure 2. They are +5 volts DC and ground.

You will notice that the interface in Figure 2 is the same as the one in Figure 1, except that its ground is common to the ground in the push-to-talk circuit. The interface draws about 3 mA maximum current so you can use #26 or even #30 wire-wrap wire. This size is very easy to thread through the expanded metal grill on the back of the unit.

Now you only need to connect one of the pins on the SEND switch. This requires further disassembly, but this is not a difficult

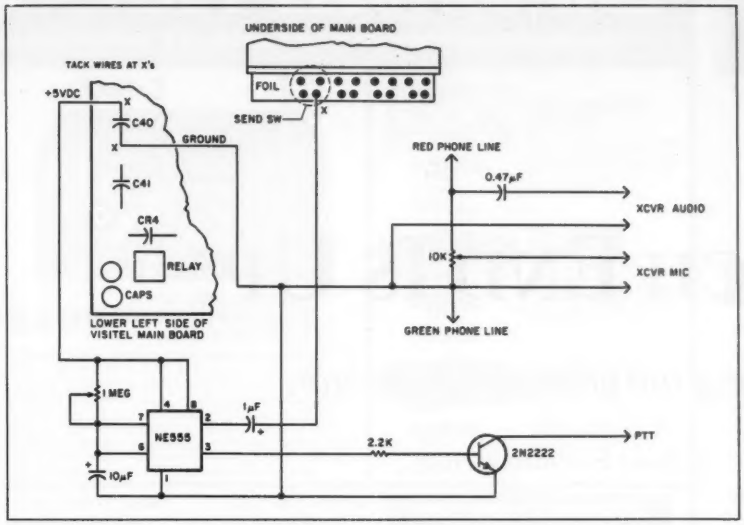

Figure 2. VisiTel/transceiver interface schematic.

procedure. When you have finished the 5 volt and ground connections, make this connection on the bottom of this same board. Free the board by removing the two large self-tapping screws from the edges of the metal cover that shields the foil side of the board. You don't have to take out all the little screws that hold this shield to the board. Fortunately, you make the connection on the exposed edge of the board, and not the part of the board covered by the shield.

The negative-going trigger pulse is applied to pin 2 through a 1 mF capacitor. The combination of the 10 mF capacitor (tantalum, please) and the 1 meg pot make up the RC network to set the time delay on the output at pin 3. Before pin 2 is triggered, pin 3 is low. When pin 2 is triggered, pin 3 goes high and turns on the 2N2222 transistor via the 2.2k base resistor. With the transistor emitter at ground and the collector connected to the transceiver push-to-talk, the transceiver is turned on for a period of time set by the RC network.

> ***"You're better off with more shades of gray and less pixels than vice versa..."***

Remove the board by lifting sideways, disengaging the head pins from the connecting strip on the top side. You will see two white wires connected to the board which you do not need to remove. Tack-solder a wire to the SEND switch terminal as shown in Figure 2. This is a negative-going pulse which will trigger a 555 timer chip configured in the monostable mode. Bring this wire out with the +5 volt and ground wires. Re-insert the header pins in the connecting strip and fasten the two self- tapping screws. Before buttoning up the cabinet again, turn on the VisiTel and check for +5 volts, ground, and a negative-going pulse on the last wire tacked to the SEND switch. (A scope or logic probe will be helpful.) Close up the case, and you're ready to connect the interface as shown in Figure 2.

Operating the Interface

The operation of the interface is quite simple. You don't have to switch the red and green telephone lines. The push-to-talk circuit is just one way of using the miraculous 555 timer.

Because picture transmission time is 5.5 seconds, set the pot so that the transceiver is keyed on for about 6 seconds and then drops out. This setting is close to the center of the pot or around 500 kΩ. A little experimenting with pot settings will get the delay just right.

After you've made all the connections, plug everything in, open the VisiTel door, and get a picture on the monitor. Press the SEND button on the VisiTel and your push-to-talk will be keyed, and you'll be transmitting your picture. At the end of transmission, your push-to-talk relay will drop out and you'll be ready to receive.

Since the picture information is sent on a bandwidth of 3 kHz or less, you can transmit on any of the amateur frequencies permitting SSTV transmission, including HF. A little DIN plug or some such connector on the leads coming out of the VisiTel might be handy for quickly disconnecting the VisiTel when your XYL wants to use it to see her grandchildren in Sheboygan! Have fun!

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MRF264	10.50	SRF3775	13.00	M57735	57.50
MRF309	29.75	SRF3800	17.50	M57737	48.50
MRF314	28.75	2N1522	11.95	M57745	87.00
MRF314A	29.75	2N3553	2.25	M57755	78.75
MRF315	41.75	2N3771	3.50	M57762	69.75
MRF315A	52.50	2N3866	1.25	M57764	74.00
MRF317	59.75	2N4048	11.95	M57712,M57733	use SAV6
MRF321	23.75	2N4427	1.25	M57737,SC1019	SAV7
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MRF458	20.00	2SC1947	9.75	7581/KT66	14.95
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MRF477	11.75	2SC2237	7.00	3CX1500A7, 4-400C	
MRF479	13.75	2SC2289	13.75	3CX3000A7, 4-1000A	
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WHICH END IS UP?

Stalking the shorted connector.

by Evert Fruitman W7RXV

The boss handed me a 4-foot coaxial cable and told me to replace the shorted end. Since he wouldn't settle for two 2-foot cables, one good and one bad, I would have to figure out which end had the short.

For a few minutes, we talked about using an RC bridge to find a break in a cable, and joked about replacing both ends of the cable, which would shorten it too much. Finally, we came up with the following idea.

Smart Thinking

Supply a fairly heavy current from a constant current source to the cable and measure the voltage drop at the end. The key here is that the the shorted end will have a lower voltage drop than the other end. The difference would be in millivolts but easily readable with a digital multimeter. Figure 1 shows the setup.

Apply the current to one end of the cable and connect a digital voltmeter directly to the cable end. Write down the reading; say, 70–150 mV. Then, without changing its setting, connect the current source and the meter to the other end of the cable and write down that reading, possibly 20–50 mV. The low reading indicates the end with the least resistance. Unless there is a pin in the cable, or the short is in the middle of the cable, the end showing the lowest voltage is the one with the problem in the fitting.

Sometimes, just applying a heavy current will burn the short out, especially if it was caused by just one strand of the fine wire used in many coaxial cables. Burning out a strand or two, however, may leave a carbon path on the cable. Even if the short clears up after you hit the cable with a couple of amps, redo the end for safety, depending on how you plan to use the cable. Especially take precautions for high frequency, high power applications. For low frequency, low power applications, it may not make much difference.

"The key here is that the the shorted end will have a lower voltage drop than the other end."

The Current-Limiting Power Source

Tying a 10–20 volt 2 amp power supply across a shorted cable could damage the power supply, the cable, or both. Finding a suitable current source is easier than it sounds. A good laboratory power supply, and many home-brew supplies, have a current-limit adjustment on the front panel. Set it for 1 or 2 amps and proceed as above. If your power supply will deliver 1–2 amps, but lacks a current-limiting circuit, add an external limiter. A large resistor or even a car headlight will do the job. Car headlights draw about 3 amps each on low beam and about 5 amps each on high beam at 13 volts. They make handy, high power resistors. Figure 2 shows the setup using a load (here, a resistor) to limit current.

While ¼ to ½ amp should furnish enough voltage drop to see on some voltmeters, the higher values will be easier to see, and they will more accurately indicate which end of the cable has the short.

Using this method, in minutes we had one cable the correct length and in service, and the shorted fitting in the waste basket. The boss was so pleased that he *almost* bought us lunch.

Perhaps the next time someone hands you a shorted cable, you will be able to tell which end is up. 73

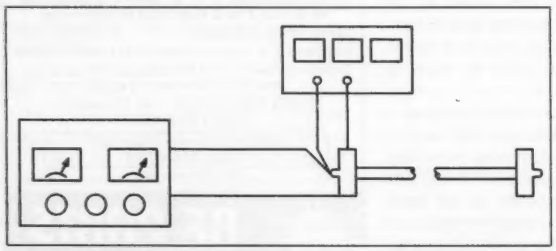

Figure 1. Basic setup to test cable. Power supply with built-in current-limiting set for 1–2 amps.

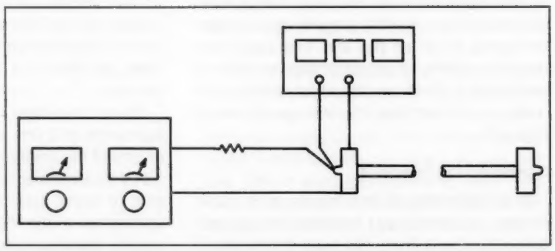

Figure 2. Setup with external current-limiting resistor. For a 1 amp 12 volt supply, use 10Ω 25 W resistor or car headlight.

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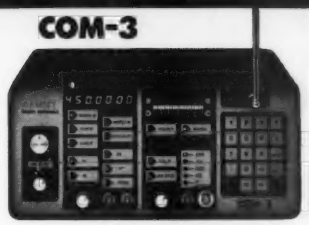

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CIRCLE 34 ON READER SERVICE CARD

COMMODORE 64 VOLTAGE PROTECTOR

An inexpensive project, a valuable safeguard

by R.T. Saponas WØYJO

When you turn on your Commodore computer, do you ever have visions of the voltage regulator going bad in the power supply, ruining ICs? Put your worries to rest. Build a Commodore 64 Voltage Protector for less than twelve dollars.

The above unpleasantness appeared on my horizon one morning as I was working on a manuscript. The screen on my monitor blinked, filled with garbage, and then went black.

I checked the power supply. As I suspected, the 10.9 volt AC supply was still working, but the 5.08 volt DC supply was now a 10 volt DC supply. I don't have to tell you what happens when an IC designed for five volts receives double that!

After buying a new power supply and having the computer repaired, I spent some time looking through electronics magazines for voltage protection devices. I found several variations of "crowbar circuits" described by Jack Eschmann in the August 1979 issue of *73*; by Ken Wyat in the November 1982 issue of *73*; by W1SL in the August 1973 issue of *QST*; and by John Pelham in the October 1980 issue of *QST*. All I had to do was lay out an experimental circuit and make it work with the Commodore supply.

Of course any regulated power supply needs an excess voltage to regulate and is thus capable of destroying sensitive circuits it's powering. It doesn't take a lot of imagination to apply this idea and circuit to other situations.

Circuit Description

Variations of the basic crowbar circuit have been used for fifteen or more years in over-voltage protection devices for commercial equipment.

See Figure 1. You place a 1.5A fast-acting fuse—fifty percent over the C-64's requirement—in series with the 5.08 volt DC line. The silicon-controlled rectifier (SCR) is connected from the output of this fuse to ground.

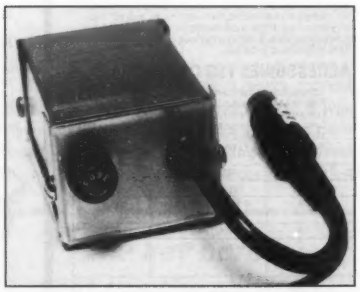

Photo A. The completed Commodore 64 Voltage Protector.

A 4.6 volt zener diode goes from the fuse output to ground through a 47Ω current-limiting resistor and a 1k resistor. Trigger voltage for the SCR is obtained from the junction of these two resistors. Use an 0.01 µF disc ceramic capacitor to bypass the gate of the SCR.

Should the DC voltage suddenly rise due to a failure in the Commodore power supply, the zener diode will start conducting. This will produce a trigger voltage on the gate of the SCR which causes the SCR to latch on. This shorts the output of the fuse to ground. The fuse will then blow, saving the computer's expensive ICs from destruction.

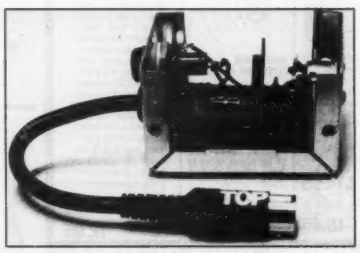

Photo B. The unit with the cover removed, showing the placement of the parts.

Construction

Begin construction by cutting the circuit board to size (see Figure 2). These dimensions allow adequate room to run the 10.8 volt AC leads under the circuit board. Drill the mounting holes in each corner. Next, use the board as a template to drill similar mounting holes in the bottom of the box. Make certain that the template is placed so that the spacing is even on all four sides. The holes in both the board and the bottom of the box should accommodate the four 6-32x½" mounting screws.

Now, prepare the circuit board for etching. Since all the traces are straight lines, you may use any method of masking. I covered the copper surface with masking tape, then used a razor blade to remove the tape from areas to be masked. Next, I applied a coat of fast drying enamel. After the enamel dried, I removed the masking tape between the sprayed areas. The board was now ready for the etching bath.

If etching a circuit board is distasteful to you, you can substitute a piece of perfboard of similar size, and hand-wire the circuit.

While waiting for the paint to dry, you can begin marking and drilling the front and back of the aluminum box for mounting the rubber grommet, the fuse, and the input DIN socket. Use a ⅜" drill for the grommet, a ½" drill for the fuse holder, and a ¾" punch for the DIN socket. If your shack doesn't have all of these tools, use the drills you have, then carefully ream out the holes with a small rat-tail file. If you use the Radio Shack fuse holder shown in the parts list, you will have to slightly enlarge the ½" hole. The manufacturer apparently used a metric measurement for this fuse-holder. Since these boxes are made of very soft aluminum, take care with the rat-tail file. A hole becomes large very rapidly.

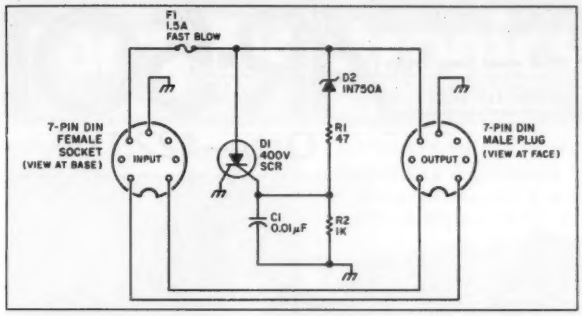

Figure 1. Schematic for the Commodore 64 Voltage Protector.

Parts List

C1	0.01 µF Ceramic	Radio Shack #272-131	$ .20
D1	400V-6A SCR	Radio Shack #276-1020	1.19
D2	1N750A Zener	4.7 V	.62
F1	1.5A Fuse (fast acting)	Radio Shack #270-1243	.35
R1	47Ω ½W	Radio Shack #271–009	.10
R2	1kΩ ½W	Radio Shack #271-023	.10
	Fuse Holder	Radio Shack #270-362	1.29
	Chassis Box (2¾" x 2⅛" x 1⅜")	Radio Shack #270-235	1.79
	Copper-clad board (2¼" x 1½")	Radio Shack #276-1591	1.00
	7-pin DIN socket		1.65
	7-pin DIN plug		1.85
	12" piece of 4-wire cable		.50

If you use fast-dry enamel, your circuit board should now be ready for the etchant bath. After you have etched and washed the board, bend the leads on the components and drill the holes as indicated in the parts layout sketch. Don't forget to drill one hole in the output trace and another hole near it, in the ground trace. Solder a 4" piece of wire in each of the holes. Later, you can cut these wires to the correct length and solder them to the input plug and to the fuse. Solder the components in place.

Mount the 7-pin socket with the socket key towards the top of the box. Next, solder the ends of the 12" piece of four-wire cable to the appropriate pins on the 7-pin plug. Strip five inches of the outer covering from the opposite end of this cable. Thread the cable through the ⅜" grommet, leaving the stripped portion inside the box. Dress and cut these wires so the two AC leads and the ground lead will lie under the circuit board after it is mounted. Solder these three leads to the proper pins of the input socket.

Mount the circuit board to the bottom of the box, using 6-32x½" machine screws and ¼" metal spacers.

Mount the fuse-holder. Solder a lead from the positive 5 volt pin on the input socket to the input side of the fuse holder.

Now, dress and cut the 4" DC lead, which you previously soldered to the circuit board, and solder it to the output side of the fuse holder. Do the same for the remaining ground lead from the circuit board, but solder it to the ground pin on the input socket. The unit is now ready for testing.

Testing and Troubleshooting

After you have finished assembling and wiring the Commodore 64 Voltage Protector, visually inspect it for wiring errors. The easiest error to make is to wire the input socket and the output plug improperly. At this point, it's a good idea to use an ohmmeter to check out this circuitry.

Apply a variable, current-limited DC voltage source to the output side of the fuse. With a voltmeter across the source, gradually raise the voltage from 5 volts until current-limiting causes the voltage to drop to zero. This means that the SCR has been triggered and is now shorting out the power supply. Turn off the power supply, and the SCR will drop out of conduction. The SCR should trigger at a point between 5.1 volts and 5.5 volts.

If you do not have a current-limited variable supply, you can make a fixed supply variable by using a potentiometer across the output. Use a 6 volt pilot lamp as an indicator of SCR firing. Solder two leads to the bulb and connect it across the fuse holder in your Protector. Remove the fuse from the fuse holder and apply voltage to the input side of the fuse holder. Again, place a voltmeter across the output voltage and gradually increase the voltage until the SCR triggers. The triggered SCR causes the pilot lamp to light, since it shorts one side of the pilot lamp to ground, placing it directly across the power supply.

If you use parts from your junk box, remember that the SCR and the zener diode are the critical parts. The tests above will help you determine if your components are okay.

After you have assured yourself that the unit is working, plug your regular Commodore power supply into it. Plug the unit into the computer, and you're ready to go. Always make certain to match the keys in plugs and sockets when you plug them together. If you force the plug into another position, you may short out your supply.

If the fuse in your Commodore Voltage Protector blows during normal operation, unplug the computer power supply from the wall socket and from the computer. Take it to your work bench and measure both the AC and the DC output voltages. If either voltage is missing, you need a new power supply. If the AC voltage is normal, but the DC voltage is 9 volts or higher, your Protector is doing its job. Buy a new supply and pat yourself on the back! 73

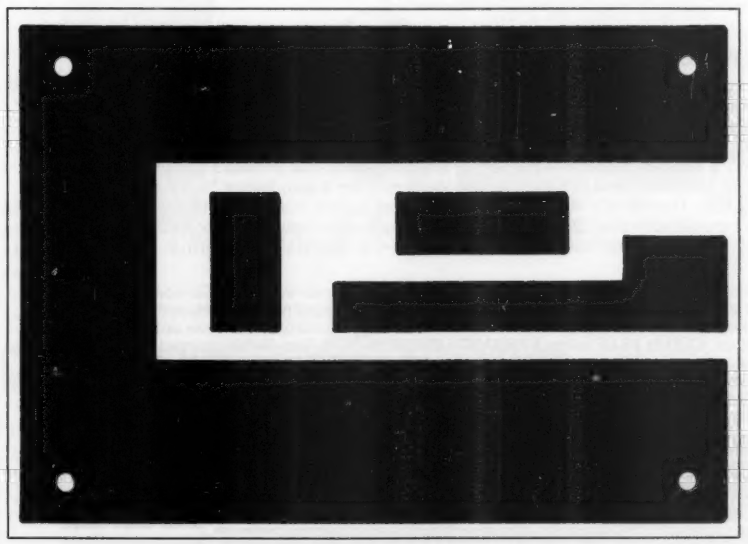

Figure 2. Full-size circuit board, foil side.

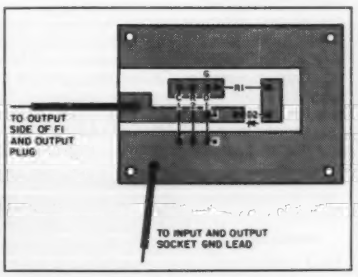

Figure 3. Parts placement layout guide.

RADIO TELEGRAPH TERMINAL

AR-501

MORSE CODE DECODER ELECTRONIC KEYER

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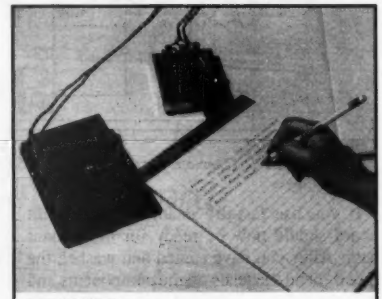
DECODER

Input level	• 10mV to 2V RMS.
Input impedance	• 8 to 1kΩ—600Ω typical
Decoding speed	• 5 WPM to 30 WPM
Audio filter	• 800 Hz ± 80 Hz Active and PLL filters 700 Hz to 900 Hz internally adjustable.



TRAINER

Code generator	• Random code generator 5 characters/code group
Speed	• 5 WPM to 30 WPM 1 WPM increment

ELECTRONIC KEYER

Paddle input	• TTL level —LO/Actuating, HI/Stop Contact input —ON/Actuating, OFF/Stop
Key input	• TTL level —LO/Mark, HI/Space Contact input —ON/Mark, OFF/Space
Keying speed	• 5 WPM to 30 WPM 1 WPM increment
Keyer output	• Transistor switching, Open collector type

SPECIFICATIONS

Model	• AR-501 Radio telegraph terminal
Power source	• DC 12V to 13.8V—165mA
Size	• 4.5"-W x 2.24"-H x 6.25"-D
Weight	• 12.5 oz. (358 g)
Controls	• Power On/Off • Random code generator On/Off • Print-out On/Off • Monitor speaker level • Electronic keyer mode select • Speed Up & Down
Display Indicators	• LCD 32 characters—16 per line • Power On—Green LED • Tuning—Red LED
Front connections	• Paddle—Standard/Iambic • Ordinary telegraphic key • Headphone/Earphone
Rear connections	• DC 13.8V input • Audio input • External speaker • Keyer output • Printer output

PRINTER PORT

• Compatible with Centronics 8-bit parallel printer. At least 4K byte data buffer is required in a printer.

BACK TO BASICS — • — • But far more advanced — — • —

The AR-501, triple mode CW terminal in a small package, is a powerful gear to practice and play with. For the Novice, SWL and Amateur radio operators it detects Morse code between 5 to 30WPM. Just plug the AR-501 to your receiver to start translating the Morse code onto full 32 character LCD display. Very simple and easy to operate. You ask; for code practice?, both receive and transmit? Yes, the AR-501 does just that. It will improve your cord reception and keying technique at the speed you want. More?. it operates as an electronic keyer both standard and iambic. More Yet? How about a printer port? You bet, the AR-501 provides parallel printer port for hard copy. You can Log the QSO, and Practice. It will help you immeasureably. We even offer a standalone Nicad operated thermal printer as an option. **ACCESSORIES SUPPLIED:** The AR-501 Radio telegraph terminal comes complete with Receiver cable, DC Power cable, Miniature Phone plug, Miniature stereo phone plug, Spare fuse, Wall receptacle style power adaptor and Instruction manual. **ACCESSORIES AVAILABLE:** CC-501 Parallel printer cable — **$30.00**/DPU-411 Standalone Thermal printer with 8K buffer.—**$235.00**

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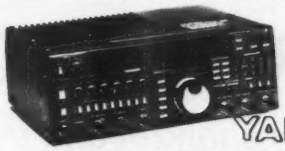

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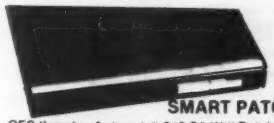

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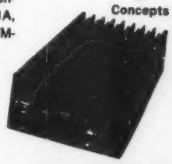

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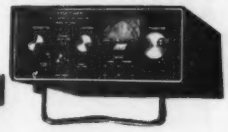

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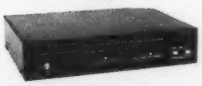

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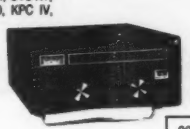

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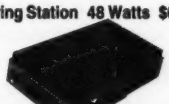

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THE HACKER'S SHACK

Transceiver from a spectrum analyzer and tracking generator?

by Steven K. Roberts N4RVE

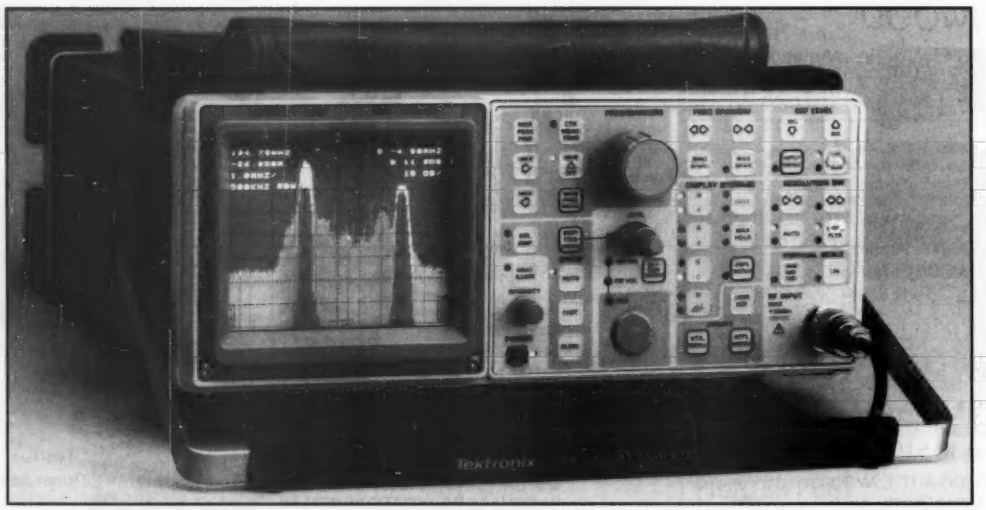

Photo A. Tektronix spectrum analyzer model 2710.

This is an interim of sorts—a time of misleading stability between bouts of nomadness. It's a respite from tire itch, a chance to develop a pot belly with unspent kilocalories, and a time to collect new equipment to further burden the already overloaded bicycle. Maggie and I are in a Silicon Valley layover, dedicated full-time to the creation of the Winnebiko III.

In the coming months, there will be plenty of space in these pages to discuss in satisfying detail the components of the new bicycle-mobile supershack. I've just started surgery on the multimode Ranger 3500 (for the 10 meter season is upon us), and many other strange projects are beginning as well. But I want to take a different approach this month, one inspired by the Hacker's Conference, rooms full of state-of-the-art test equipment, and a mad vision of future radio.

Bizarre and Colorful

A hacker, contrary to the recent slanderous allegations of CBS News, is not a computer criminal or some kind of evil-minded revolutionary. Those do exist, of course, but not in the subculture of creative genius that lies behind every new technology. A hacker, quite simply, is one who derives the greatest possible pleasure from circumventing limitations; a designer who leaps the boundaries of convention, pushes new ideas past the skeptical mainstream of an industry, and stays up all night in the wild-eyed fervor of creative insanity. Hackers are a bizarre and colorful bunch, and when I attended a whole conference of them in the Santa Cruz mountains this month, I witnessed an unrestrained intellectual energy that was almost frightening. It certainly seemed to frighten CBS...which showed images of my bike while speaking ominously of a band of revolutionaries gathered in the hills, plotting their next attack on the valley below.

The hacking phenomenon is generally associated with computers, for it has spawned such phenomena as the Mac, Hypermedia, and all manner of whiz-bang software and graphics magic. But any technology with a future is, by definition, eminently hackable...so let's consider the "radio hacker" and what his or her station might look like.

The Ultimate Rig?

First of all, let's agree on something. This rig has to be realistic, something you could assemble today. We're talking real technology here, not dreams of future offerings from the Big Three. The fantasy is that these tools will someday be available for less than the hundred grand that they would cost right now... One of our general requirements is total agility in the electromagnetic spectrum, along with the ability to generate and demodulate any communication mode. We should be able to track mysterious signals, even if they're drifting, and determine their spectral content. We need to freeze events in time, pretriggering if necessary. All types of signal encoding, analog or digital, should be emulated in software. There should be plenty of clean power to the legal limit, robust antennas, and convenience features such as total remote control and automated operation. And, to satisfy the hacker within, there must be endless reserve capability for trying out

new ideas and probing the limits of existing systems.

In a sense, any radio receiver is a spectrum analyzer, but one with a narrow window that moves with the cursor. What if we opened up the view of the spectrum, covering the famed "DC to daylight" range at any level of magnification? It turns out we don't have to invent this at all; they're available off the shelf from Tektronix and Hewlett-Packard.

One of the least expensive spectrum analyzers in this class also has some of the most interesting features. The Tektronix 2710 (see Photo A), covering the fairly modest range of 10 kHz to 1.8 GHz (most of their models go to 325 GHz), offers the interesting feature of demodulating any signal highlighted by the cursor, with AM, FM, and rasterized video the basic options. What if we take one of these analyzers and give it a high-gain tunable front end, a product detector, and a GPIB interface cable to a host computer? Do we have a passable receiver?

To find out, I spoke with a few Tek engineers, and sure enough, it's not a mad idea at all. In fact, Stan W7NI and Ken N6RO have dreams of making an all-Tektronix QSO between Portland and San Francisco using only off-the-shelf test equipment. The transmitter? How about a tracking generator that follows the spectrum analyzer's sweep, locked on frequency by setting the instrument to zero span during a QSO? I've watched the machine handle video, 2 meter FM, and AM broadcast with equal felicity. You just set the cursor to an interesting peak or a specific frequency and tell it to demodulate to a built-in speaker or the screen. All bands, all modes, any bandwidth, computer control, graphic user interface...not bad for $10,000!

Once a true hacker starts thinking like this and ignoring price, things rapidly get out of hand. By the time we add a broadband kilowatt linear, a full-size log periodic along with other appropriate antennas, and full remote control of the whole system via laptop computer and 9600-baud TNC...we have a pretty hard-core ham station.

A License to Tinker

In reality, of course, commercial spectrum analyzers are not optimized to perform as receivers. There are many features we have come to expect in communications gear, including IF passband tuning, and so on. But I suggest this not-entirely-absurd concept to make a point: we've grown so accustomed to buying special-purpose boxes to handle the essence of our hobby that the original spirit of ham radio has become almost vestigial, present only in the hard-core cadre of wizards and inventors who keep bringing us new toys.

It's a dangerous pattern. I've met a number of packeteers, for example, who really don't know what's going through those wires between computer, TNC, and HT, other than something vaguely defined as "data." While there's a lot to be said for a turnkey radio data communications technology available to the masses (I'm all for it), we hams carry a license to tinker. Even though this hardly constitutes an obligation, it sure as hell is a *pleasure*...and as the average intelligence and education of the American human slowly falls, we find ourselves in the position of being the only ones outside the engineering labs who can actually make electronics work. That the designers among us are on the decline, I find disturbing.

The energy at the Hackers' conference typified the spirit that should appear in the top 1–2% of ham radio operators: a mad, almost obsessive desire to build new systems (or make the old ones perform beyond the dreams of their creators). If this touches something within you, by all means...go for it!

Photo B. The Createc SC02.

Radical Oscilloscopes

All this talk of test equipment reminds me: a few months back in these pages, I lamented that I carry no oscilloscope on the bike. That has finally changed. There are too many situations where the complexities of the system demand something a little more capable than a logic probe and multimeter.

The Createc SC02, shown in Photo B, is a West German marvel that packages, in less than 2 pounds, a complete dual-channel 20 MHz storage scope with 46 waveform memories. It can perform calculations between the incoming channels, or between either of them and any stored waveform. It has four cursors per channel, with digital read-out of their relative time and amplitude values. Ten "setup memories" allow you to recover weird configurations, and the 50-key keyboard lets you define every conceivable scope parameter with a structured command language. There is even a multimeter mode, which is more exciting than it sounds: a replica of the waveform is displayed in the lower right corner while the bulk of the screen presents a constantly updated table of peak-to-peak, zero-to-peak, average, RMS, period, and frequency...complete with calculated maximum error percentages based on the position of attenuators and various internal factors!

This unit is quite a departure from traditional oscilloscope designs, and the company is introducing a model early in 1989 that carries the concept to its logical conclusion: an optically-isolated RS-232 link will allow the SC04 to serve as a data-acquisition front end for digital signal processing, QC, or any other "smart instrumentation" application.

Power for the scope is provided through an external cable that carries +5 and +/−12, power easily derived from the existing switching supplies on the bike. I also carry a small AC supply for extended sieges at a bench, such as the one that's going on now. Interestingly, this little unit is so comfortable to operate and so easy on the eyes that I'm finding it preferable to traditional lab scopes, except in those rare cases when 20 MHz simply isn't enough bandwidth.

In next month's installment, we should have a look at an important part of the new bicycle-mobile ham shack, the Ranger 3500 10 meter rig. Until then, cheers from somewhere in the electromagnetic spectrum! 73

NOTE: For further information on the Createc SC02 hand-held oscilloscope, contact Ken Pine, Createc, 337 Kifer Road, Santa Clara, CA 95051; 408-738-3744.

For information on the Tektronix 2710 Spectrum Analyzer, call 800-835-9433 and ask for your nearest sales office.

Finally, my Computing Across America *book continues to be available for $9.95 plus $2 shipping from: Computing Across America, 1306 Ridgeway Ave, New Albany, IN 47150.*

by Bryan Hastings NS1B

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It was bound to happen. With the explosion of on-line services—into which anyone with a computer and a modem can call to get all kinds of information and perform all kinds of interactions, such as reading the up-to-the-hour UPI news, booking a plane ticket, or participating in one of hundreds of forums covering topics from (yes, Amateur radio!) to Zoology—someone would get around to putting a callsign information service on-line. This "someone" is Buckmaster Publishing, and the service is Hamcall.

Getting Set

After signing up for the service, Buckmaster sent me a page and a half of instructions. It supplied the necessary information for getting on-line and using the service. This included a five-digit password, access phone number, modem settings, and baud rates (Buckmaster supports 300, 1200, and 2400 baud modems), and extra help with the service, which is basically menu-driven.

Operation

I had to follow the instructions carefully when I first signed on. Unlike most on-line services, no introduction appears when Hamcall answers the call. As stated in the instruction sheet, the service waits for the user to send two returns in order to determine the user's system baud rate. (My system is a Standard Turbo 10 micro (a PC Turbo clone), BCN Smartlink II modem, and Crosstalk XVI communications software.)

The service then asked for my password (five digits). After having called in a few times, I discovered that it always tells you on the first entry that the password is incorrect, whether or not you entered it correctly. Typing in the password correctly the second time brought me to the next step, where it asked for my callsign. After giving that, I had access to the directory.

Operation was basic from then on. The service simply asked, "What Call:" After I gave it a callsign, it took a few moments to display the associated name and address, and then immediately repeated the query. When I gave it a call for which it had no information, it came up with "No Match." Typing "bye" signed me off the system. That's all there was to it!

Once I gained some facility with getting on the service, it took about two minutes to get to the directory, which cost between 50 cents and a dollar for the toll call.

HamCall vs. *Callbook*

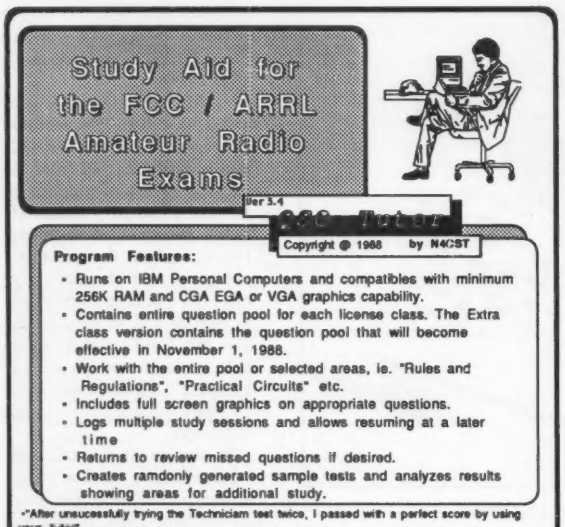
There are three elements, or "fields," involved—callsign, name, and address. Both Hamcall and *The Callbook* have only the callsign as the search field, i.e. they are useful only to find an unknown address and/or name from a known callsign. On the down side, Hamcall gives information only on hams with US licenses. On the up side, Hamcall's directory is updated every month—compared to the *Callbook's* quarterly updates, which involves referencing up to four different sources (the yearly *Callbook* and three supplements). It also retains previous callsigns of upgraders for up to one year. Buckmaster flushes out the old calls every December. I changed my call from KA1HY to NS1B on 14 June, and Hamcall, in early October, produced my name and address under both calls.

Time and $$$ Considerations

Hamcall doesn't offer any real advantage to a ham who looks up only one or two calls every once in a while. US VHF and above contesters and DXers, WAS chasers, and others who need to find the addresses of many US licensed hams, however, would find Hamcall a real eye- and time-saver. Since the system operates in full-duplex mode (i.e., it can receive and transmit simultaneously), if you are equipped to do the same, you can lessen connect time by typing ahead of the service response. Just turn on the capture function to save to disk, and enter the calls one after another. Hamcall spends about 4–6 seconds per search for a callsign. One hundred searches thus means between 7–10 minutes of connect time. At ATT evening rates (35% off), this comes out to a maximum of $2 for the toll from anywhere in the US. With a little ingenuity, and the appropriate software, you can print out these addresses onto mailing labels and affix them to QSL cards!

Conclusion

Hamcall is convenient and easy to use, especially for those already familiar with the workings of micros and modems. Hopefully, Buckmaster Publishing plans to get international callsign information, and perhaps even name and address search field options, on-line in the not-too-distant future. (Until recently, Buckmaster published *Name and Geographical Index Callbooks*). All in all, however, Hamcall is a good start for a service very much needed in the ham community. 73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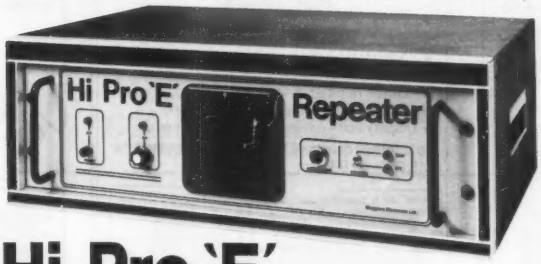

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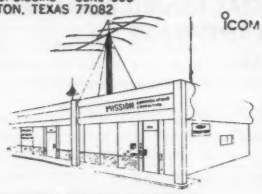

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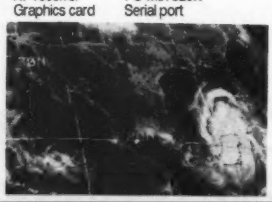

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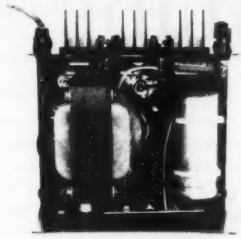

INSIDE VIEW — RS-12A

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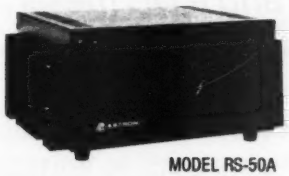

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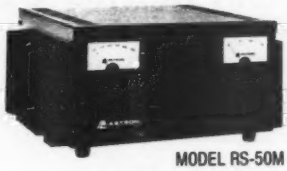
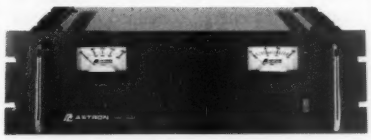


MODEL RS-50M

MODEL VS-50M

RM SERIES



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19″ × 5¼ RACK MOUNT POWER SUPPLIES

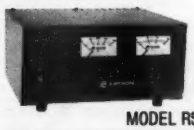
MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RM-12A	9	12	5¼ × 19 × 8¼	16
RM-35A	25	35	5¼ × 19 × 12½	38
RM-50A	37	50	5¼ × 19 × 12½	50
• Separate Volt and Amp Meters				
RM-12M	9	12	5¼ × 19 × 8¼	16
RM-35M	25	35	5¼ × 19 × 12½	38
RM-50M	37	50	5¼ × 19 × 12½	50

RS-A SERIES

MODEL RS-7A

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-3A	2.5	3	3 × 4¾ × 5¾	4
RS-4A	3	4	3¾ × 6½ × 9	5
RS-5A	4	5	3½ × 6½ × 7¼	7
RS-7A	5	7	3¾ × 6½ × 9	9
RS-7B	5	7	4 × 7½ × 10¾	10
RS-10A	7.5	10	4 × 7½ × 10¾	11
RS-12A	9	12	4½ × 8 × 9	13
RS-12B	9	12	4 × 7½ × 10¾	13
RS-20A	16	20	5 × 9 × 10½	18
RS-35A	25	35	5 × 11 × 11	27
RS-50A	37	50	6 × 13¾ × 11	46

RS-M SERIES



MODEL RS-35M

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H × W × D	Shipping Wt. (lbs.)
• Switchable volt and Amp meter				
RS-12M	9	12	4½ × 8 × 9	13
• Separate volt and Amp meters				
RS-20M	16	20	5 × 9 × 10½	18
RS-35M	25	35	5 × 11 × 11	27
RS-50M	37	50	6 × 13¾ × 11	46

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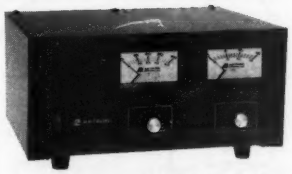

MODEL VS-35M

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MODEL	Continuous Duty (Amps) @13.8VDC	@10VDC	@5VDC	ICS* (Amps) @13.8V	Size (IN) H × W × D	Shipping Wt. (lbs.)
VS-12M	9	5	2	12	4½ × 8 × 9	13
VS-20M	16	9	4	20	5 × 9 × 10½	20
VS-35M	25	15	7	35	5 × 11 × 11	29
VS-50M	37	22	10	50	6 × 13¾ × 11	46
• Variable rack mount power supplies						
VRM-35M	25	15	7	35	5¼ × 19 × 12½	38
VRM-50M	37	22	10	50	5¼ × 19 × 12½	50

RS-S SERIES

MODEL RS-12S

• Built in speaker

MODEL	Continuous Duty (Amps)	ICS* Amps	Size (IN) H × W × D	Shipping Wt. (lbs.)
RS-7S	5	7	4 × 7½ × 10¾	10
RS-10S	7.5	10	4 × 7½ × 10¾	12
RS-12S	9	12	4½ × 8 × 9	13
RS-20S	16	20	5 × 9 × 10½	18

*ICS—Intermittent Communication Service (50% Duty Cycle 5min. on 5 min. off)

CIRCLE 16 ON READER SERVICE CARD

TROUBLESHOOTING GUIDE FOR SWITCHING POWER SUPPLIES

Trace the problem quickly with just a scope and a DC meter.

by Ed F. Rice W9NGP

Ever had trouble with your switching power supply, but didn't know where to start to find the problem? Well, the troubleshooting guide in Figure 4 presents a sequence of tests to follow when there is no output from a switching supply. It outlines strategic tests that quickly eliminate testing of whole sections of the circuitry at once, so the defect can be quickly isolated without the need to test a large number of individual components.

Switching supplies are subject to all the failures of conventional supplies: destruction of diodes in the input rectifier due to transients on the AC line; chokes, diodes, and transistors damaged by shorted load (because of the high efficiency of switching supplies, a shorted output results in a very high voltage elsewhere in the circuit); and overheating due to inadequate ventilation or skimpy heat sinks.

Switching Supply Components

The block diagram of a switching power supply in Figure 1 shows the overall relationships between the circuit divisions.

The input rectifier is often a simple ½-wave system which rectifies the line voltage and sends low voltage DC to the switch signal generator and the AC power switch. A bridge rectifier is used in high power units.

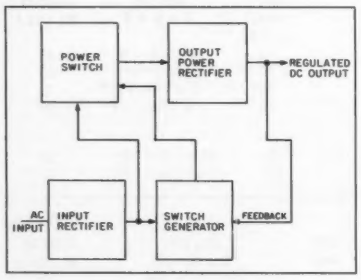

Figure 1. Box diagram of the relationships of the different circuits in a switching power supply.

The AC power switch is composed of a power MOSFET feeding the output choke and damper diode. The MOSFET is switched on and off at 50 kHz to 100 kHz by square waves of varying duty cycles applied to the gate. Regulation is accomplished by changing the duty cycle (not the frequency) to correct for variations in the output voltage. Figures 2a and 2b show a transformer-less single MOSFET circuit and a push-pull version used in high power supplies.

> ***"It (the troubleshooting chart) outlines strategic tests that quickly eliminate testing of whole sections of the circuitry at once"***

The output power rectifier, shown in Figure 3, is always a full wave center-tapped circuit in high power units. D3 is a type of damper diode which conducts when the field around the choke collapses, charging the output filter. This is the source of output power.

The combination of C3, R1, and D4 is called the "buffer" or "snubber" circuit. It shorts out the energy contained in the high voltage spike across the transformer secondary when the field collapses at MOSFET cutoff. An open diode, D4, can be disastrous to the transformer, MOSFETs, and diodes.

The switch signal generator is usually a chip containing a flip-flop, a comparator to sense the feedback, a soft-start circuit to protect the MOSFETs from being overdriven before the output voltage builds up, and shutdown circuitry in case of an overload.

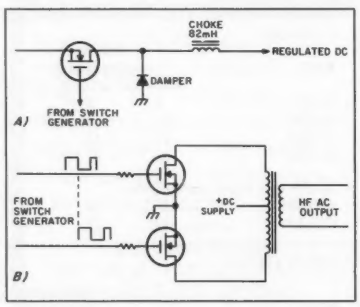

Figure 2. a) Transformer-less single MOSFET circuit. b) A push-pull version for high-power power supplies.

Troubleshooting Strategy

When there is no output voltage, begin the process of troubleshooting by observing the waveshape at the gates of the MOSFETs.

As indicated on the chart in Figure 4, the result of this test divides the power supply into two parts and confines further testing to one-half of the circuits. If you find any waveshape at the gates when the output is zero, it is likely to be very distorted from the normal because the regulator will be straining to increase the output voltage.

The presence of any signal at the gates indicates that the input rectifier and the switch signal generator are probably working fine. This leads to a check of the DC voltage across the damper diode. A DC meter will not read accurately at this point because of the

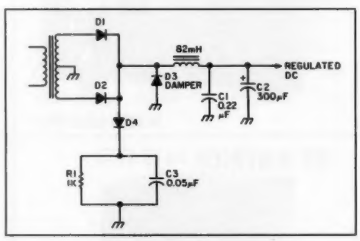

Figure 3. Schematic of the output power rectifier.

presence of an AC component. For most troubleshooting, at this point it is enough to know if DC is present or completely absent, so your meter will do the job. When you find a DC voltage across the damper, and there is no DC output, the chart in Figure 4 suggests three parts that could be defective.

If the damper voltage is missing, a check for the presence of any signal at the secondary of the power switching transformer is in order. As before, at the MOSFET gates, any signal at the secondary will be considered acceptable. The chart indicates three parts to check when there is a signal. And, if the signal is missing, the four possible causes of failure are shown.

"When no output voltage, begin troubleshooting at the gates of the MOSFETs."

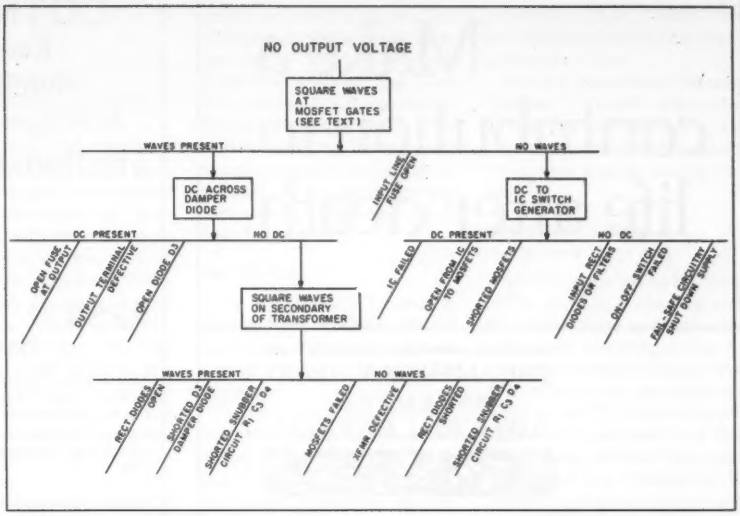

Figure 4. Troubleshooting guide for your switching power supply.

The right side of the troubleshooting guide suggests a procedure when there is no signal at the MOSFET gates. It is not necessary to test anything in the power switch or output rectifier systems. Tests are confined to the input rectifier and the IC, beginning with a check of the input line fuse. This is followed by a test for DC input voltage to the chip.

Often, troubleshooting a switching type power supply is easy because the high power available leads to charring or total destruction of the components involved in the failure, and it may not be necessary to make many tests. However, even when the failure is not obvious, you can usually trace it quickly with a scope and a DC meter. FI

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75 Meter USATVS Net

Old man winter has arrived, and I hope all you UHFers in TV-land got a chance to install your hard-line, mast-mounted preamps and multi-element, high-gain antenna arrays before the cold weather hit. If you didn't, now is the time to do it! I also hope you had time to get your 75 meter dipole up in the air, pruned for the 3.871 MHz national ATV user's net hotspot and DX coordinating frequency.

The USATVS sponsored net meets regularly every Tuesday night for about two to three hours, from 8 to 10 p.m. Eastern time. WB8ELK, WA4UMU, WBØZJP, and WBØQCD usually handle net control duties. Many ATVers use this HF frequency on week days, as well as on the weekends at night and in the early morning, during the best hours for band enhancement. So far, all states except California check in.

AAØP, WBØCZI, and the new Denver, Colorado, ATV troops talk cross-country into the Iowa BRATS, Indiana and Ohio ATCO group areas, while WA2OSW, W2RPO, and others in New York talk with W3SST, W3QNI, WA3USG, and the Pennsylvania group. WBØYNH, WA9NJR, and WBØQOX of the 3M Minnesota ATV Club exchange FSTV ideas with K4NHN and WA4UMU of the Palmetto, South Carolina, ATV group. Even W3LGV and W4PLA in the Orlando, Florida, ATV Club have talked about ham TV with WA8AHY, WA8ASH, WB8AMZ, and others in the Michigan area. It's a lot of fun keeping in touch with other ATV groups/clubs on a weekly schedule. The USA is finally uniting in the sharing of ideas and opinions, and helping to solve problems by coordinating on frequencies to work each other on video UHF TV mode.

New AEA FSTV-430 Transceiver

As hinted at in previous columns, a major amateur radio manufacturer has come out with a product in a new line of fast scan television gear. Advanced Electronics Applications, Inc., of Lynnwood, Washington, unveiled their new FSTV-430 model UHF 70 cm transceiver last September at the Virginia Beach, Virginia, and Portland, Oregon (National ARRL Conference), hamfests. I have known about this development since Dayton in April, but Mike Forsyth and Mike Lamb of AEA asked me to keep a lid on the information. It was tough to do, and a few who saw the smile on my face at local hamfests figured something was up.

No doubt Kenwood and ICOM will be watching the sales of this new piece of AEA gear, as they have already begun asking amateurs if they own a camera and VCR or not. Hopefully, AEA's introduction of reasonably priced, straightforward, and simple to operate fast scan TV equipment is the beginning of a new surge of interest in a mode that has yet to reach its prime in the ham world. This competition also forces existing ATV manufacturers to become more responsive to customers' needs. That has been a sought-after condition in ATV for a long, long time!

AEA's new FSTV-430 ATV transceiver is a crystal-controlled transmit and receive system. Two channels are available. The unit comes stocked with the popular 439.250 MHz national ATV calling and operating frequency. I wrote to AEA to ask them to take a second look at producing a tunable downconverter receive system, since many ATVers (especially DXers) monitor more than just one UHF frequency. Many also need to check both ends of the 70 cm band for the more than one hundred 421.250 MHz ATV repeaters in the country.

The unit comes standard with a 4.5 MHz FM audio subcarrier offset, and all the usual camera video and audio input connections. RF output power is 1 watt AM. Higher power amplifiers are readily available from Mirage, Tokyo Systems, Alinco, and others, to boost power from the new AEA exciter to a 20 or 50 watt level. I have asked to do *73 Magazine* and *Spec-Com Journal* reviews on this new product. By the time this column appears, the first finished models should be in the stores. Look for this hot, new item at Dayton in 1989. The October issue of *QST* and the November/December issue of *The Spec-Com Journal* 1988 carried the first information, with pictures, on the AEA FSTV-430 rig. Thank AEA for this new addition to an already impressive line of digital components! Who will be the first on your block to own one?

For Info On...

For Slot antenna information, contact Merle Reynolds W9DNT of Moline, Illinois, and Gerald Cromer K4NHN of Cayce, South Carolina.

Pauldon Associates (W2WHK, 210 Utica Street, Tonawanda NY 14150; 716-692-5451) has some interesting 400, 900, and 1200 MHz bricks, preamps, exciters, switchers, and power modules. We have one of their 10 watt amplifiers on our BRATS 910.25 MHz weather radar transmitter running twenty-four hours a day, and it works great! Send an SASE for a catalog of their products.

Rutland Arrays now has a new broadband, high-gain ATV modified K1FO 22-element 70 cm yagi antenna for $88.95. Contact Tom at 1703 Warren Street, New Cumberland PA 17070.

Don and Sue Miller of Wyman Research, PO Box 95, Waldron IN 46182, are promoting FM TV gear, and a new on-carrier sound TV receive module adapter for $90.

Welcome ATV Mode Newcomers

As AEA begins selling their new FSTV product, hundreds and hopefully thousands of new ATVers will be getting on the 70 cm band! AEA is counting on new ATV purchasers, not those already on ham TV. Most sales will hopefully be generated from this area. I agree with that. Therefore, to help AEA and *73 Magazine*, in the next issue of this column, I will begin a series of "newcomer" ATV articles. This might be a bit boring for you old-timers, so please be patient in your future reading. We need to go over ATV basics—how to get started, antennas and feedlines, and so forth, for the benefit of those who are just getting involved with ham TV. The future of this mode depends on it!

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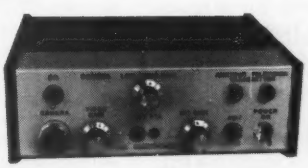

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73 Book Review

The 1934 Official Short Wave Radio Manual

Gernsback classic reprinted for old-timers and young squirts alike.

Reviewed by Douglas Stivison NR1A

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The "Never Say Die" column has often lamented that, for many of us, the hobby just isn't as much fun as it used to be. Something very special was lost when we abandoned our home-brew rigs and tinkering skills in favor of the vastly superior performance of today's mass produced, high-performance transceivers. Certainly we gained mind-boggling performance, but somehow we lost our innocence in the process. And we lost the magic, the excitement, and the romance that always accompanies innocence.

Today we routinely fill our logbooks with 5-9 reports from the far corners of the world, but somehow the romance is gone. If we ourselves have forgotten the excitement and the magic of radio, it is no wonder that we can't convey these feelings to the next generation, and why we cannot attract newcomers to our ranks.

"Radio" Was Synonymous with Adventure

In the 1930s, however, things were entirely different, and the very word "radio" was synonymous with adventure and the call of faraway places. Technology was a lot simpler then and much more approachable. Time was plentiful, and if cash was hard to come by, there was no lack of ingenuity and scrounging to take over where the pocketbook left off.

Certainly no individual was a more powerful force behind the popularization of radio than Hugo Gernsback. In a variety of magazines, books, and contests, he not only showcased the excitement and romance of the burgeoning science, but he pioneered a style of nitty-gritty, how-to-do-it articles that have never been surpassed for their clarity or completeness. Circuits appearing in any Gernsback book were meant to be duplicated, and just about every radio tinkerer of the era had built at least one radio out of a Gernsback book.

Gernsback became better known for his publication of "pulp" science fiction, and to this day, the highest award a science fiction writer can win is the prestigious "Hugo" award named in his honor. But to a generation of radio amateurs, the Gernsback name is associated with a plethora of radio magazines. And of this range, *Radio Craft* and later *Short Wave Craft* were among the most enduring.

Hugo Gernsback's Classic

Lindsay Publications has come out with a reprint of Gernsback's classic *1934 Official Short Wave Radio Manual: Complete Experiments, Set Building, and Servicing Guide*. No longer is this gem just for the cognoscente able to pay the auction price at collectors' meets. No, today everyone can afford this fascinating and fully illustrated book.

"We routinely fill our logbooks with 5-9 reports from the far corners of the world, but somehow the romance is gone."

The work was originally put out under Gernsback's *Short Wave Craft* label and it contains over 250 pages of classic how-to-do-it articles for a host of early radio projects. Everything, from one-tube regen receivers to 5 meter transmitters and receivers, is covered. Here are "portable" radios that look like they outweigh a typical Toyota.

This book is a road map through the lost world of grid leaks and tickler coils. It is like a time capsule, made when the hobby was going through one of its most exciting eras. There are also about a hundred schematics of the most popular commercial radios of the day, including such immortals as the Pilot Super-Wasp, the National NC-5 "Thrill Box" and the Hammarlund "Comet."

There are also some intriguing feature articles, including one by the late Don Wallace W6AM on improving antenna performance, and one by the legendary John Reinartz titled "A Receiver That Laughs at Static."

Not Just Nostalgia

But the book is much more than just a stroll down memory lane. Publisher T.J. Lindsay augments this reprint with a final chapter of totally new material, showing how to adapt the classic circuits in the book to construction using modern semiconductors for the original expensive and hard-to-find tubes. The book then becomes a hands-on build-it-yourself book, and I am sure that Gernsback himself would want it this way.

Without any heavy mathematical formulae (that would be totally out of keeping with the seat-of-the-pants tone of the original book), Lindsay lists his own experimentally determined values for modifying biasing components, "grid leaks," and coupling capacitors when substituting JFETs, such as the ubiquitous MPF102, for a wide variety of early triodes, and using dual gate MOSFETs, such as the workhorse 40673, for the popular screen-grid tetrodes.

Lindsay uses bipolar transistors as alternatives to early audio amplifiers. He gives a wealth of information on scrounging parts, and on building breadboards and cabinets to recreate the feel of the old radios. . .even if they are using modern semiconductors as the active devices. I feel that just this final chapter of seat-of-the-pants experience would justify the price of the book.

This is a great book for nostalgia fans who lived through the radio era of the early 1930s. It is an equally great book for those who were born later, but who are the heirs to the home-brewing and experimenting legacy that this era produced. And with the final chapter on building simple regenerative receivers with a combination of old and new parts, it is a gateway to building a circuit that is not sealed in a chip or wired by a robot on a Japanese assembly line. It is a hands-on guide to using radios that you actually build yourself. In fact, while reading Lindsay's comments on using a grid dipper, I could not help recalling hundreds of classic *73 Magazine* how-to-do-it articles by the likes of W6BLZ, W7OE, K5JKX, W1DTY and K1CLL in the 60s and early 70s.

For anyone who might have lost touch with the magic that first attracted them to our hobby, this book is a superb way to get the fires burning again. 73

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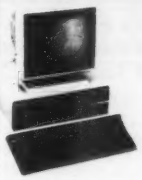

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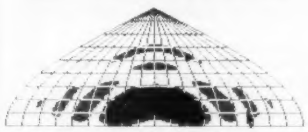

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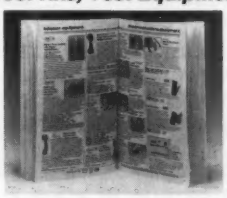

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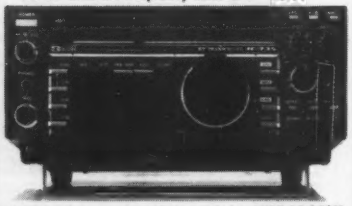

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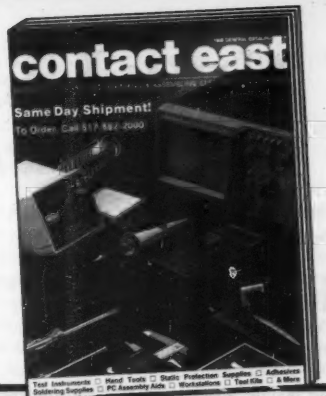

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NEW USES FOR OLD METERS

Have the meter measure what you want it to.

by John R. Somers KC3YB

Recently, while I was assembling parts for a power supply I was building, I found I had everything I needed in my junk box except a suitable meter. While I had no shortage of meters of all shapes and sizes, I had nothing that would give me the right full-scale reading.

Inspecting the meter faces, I discovered many of them had, in addition to the scale markings, identification as to the type of movement they contained. Unfortunately, there seemed to be little standardization. Some of the meters indicated the amount of current required to give a full-scale indication, such as 0–1 mA, while others rated the movement in a certain number of ohms per volt. None of this seemed to have anything to do with the original function of the meter.

Meter Discoveries

With a little thinking about that most basic of formulae—Ohm's Law—I realized the current rating of the meter movement and the ohms-per-volt rating are intimately related. One is merely the reciprocal of the other! The number 1 divided by the full-scale current will result in the ohms-per-volt rating, and vice versa.

I then recalled that the value of a very low resistance shunted across the meter determines the range of an ammeter. A voltmeter has a much higher resistance in series with the meter for the same reason. This seemed simple enough until I realized the internal resistance of the meter would, in either case, be part of the circuit. Before I could determine the required resistance of either a shunt or multiplier, I was going to have to know the internal resistance of the meter. A quick check with an ohmmeter convinced me I was likely to burn up the internal workings of the meter before I could determine its resistance. How, then, was I going to do it?

A Full-Scale Meter Reading

To test the meter, I placed it in a circuit containing a battery and a variable resistor (R1 in Figure 1) that adjusts to limit the current flow to the point at which the meter gives a full-scale reading. I placed a second variable resistor, R2, across the meter to divert part of the current. When the meter reads half-scale, both meter and R2 present the same resistance to the current flow. Removing R2 from the circuit and measuring its resistance reveals the resistance of the meter movement. This is a simple system, complicated only by the fact that some meters have internal shunts or series resistors that must be removed before measuring the meter.

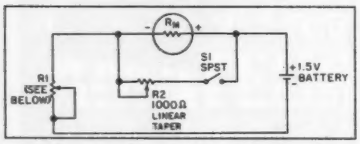

Figure 1. A simple circuit for determining the internal resistance of a meter. R1 is a 100kΩ linear-taper variable resistor. If full-scale current of the meter is known, the following formula yields greater accuracy:

$$R1 = 2x \frac{\text{battery voltage (Volts)}}{\text{full-scale meter current (Amps)}}$$

Meter Circuits

After selecting a meter that suited my application, I used the formula in Figure 2 to determine the shunt value I needed to add to produce a full-scale reading. Because a meter typically has a low internal resistance, the shunt value will generally be much smaller in value so that most of the current flows through the shunt rather than through the meter. This resistance may be 0.01Ω or less. A resistor of such a small value may not be easy to get, but you can make a perfectly workable substitute with a length of wire. Table 1 lists a number of common wire gauges and the resistance per foot. You can easily calculate the length of a wire you need to equal a desired resistance.

Remember to keep power-handling capability in mind. This will not generally pose a problem, but be on the safe side. Use the largest gauge wire you can. Although the table refers to bare wire, insulated wire can be used just as well. You can wind a wire shunt around a dowel and solder it to the meter terminals to conserve space.

The voltmeter circuit in Figure 3 uses a series or voltage multiplier resistor to extend the meter's range. In this case, a suitable external resistor will be easier to locate, as it will be many times the internal resistance of the meter. If you can't come up with the exact value you need, combine junk box resistors in whatever manner necessary to produce the desired resistance. In both circuits, meter polarity must be observed.

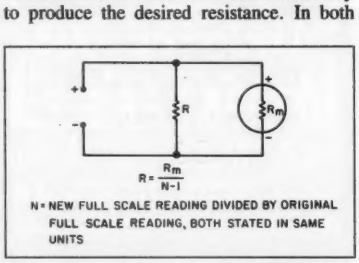

Figure 2. An ammeter circuit, and the formula for determining the shunt value for a meter of known internal resistance.

Calibrating Your Meter Circuit

Once you have completed the desired meter circuit, it must be calibrated before it is much good to you. The voltmeter is the easiest to calibrate accurately. Using a variable voltage source, connect the meter in parallel with another voltmeter of known accuracy across the supply. A digital voltmeter works best. As the voltage is adjusted, make light pencil marks on the face. Dry transfer numerals can then be added.

To calibrate the ammeter, place it in a series circuit that contains a known voltage and resistance. If you have a large, adjustable, wire wound power resistor, it will be perfect for the job. Otherwise, you can mix and match a handful of power resistors of various resistances to produce desired amounts of current flow. Make certain your resistors are up to the job.

Throughout this article, I have referred to voltmeters and ammeters. Actually, with proper shunt and multiplier resistances, your surplus meters can display a wide range of current or voltage readings, regardless of the uses for which they were originally designed.

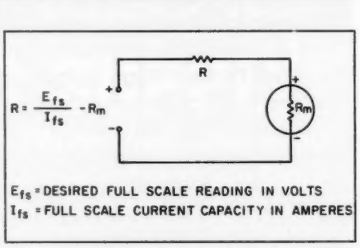

Figure 3. A voltmeter circuit, and the formula for determining the voltage multiplier resistance for a desired meter range.

References

1. *Radio Amateurs Handbook*, 1967.
2. *Allied Electronics Data Handbook*, 1966.

Resistance of Standard Annealed Copper Wire

Gauge	Ω per foot	Gauge	Ω per foot
4	0.0003	18	0.006
6	0.0004	20	0.010
8	0.0006	22	0.016
10	0.001	24	0.026
12	0.002	26	0.041
14	0.003	28	0.065
16	0.004	30	0.103

RTTY LOOP

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Trying Harder to Be Friendly

Let's begin right off with that traditional, friendly greeting that rings in your ears this season—HAPPY NEW YEAR!

Friendliness is an interesting concept, because this hobby of ours often exhibits two opposite poles of the emotion. Certainly many of us were brought into this hobby by a friend. The tradition of lending a helping hand, teaching each other, and kindling that amateur spirit makes amateur radio a unique hobby.

But often enough, this hobby of ours, with its wires, gizmos, blinking lights, and high-tech talk, can be downright unfriendly and even hostile. The facet of amateur radio that I write about, radioteletype and digital communications, may well be one of the hardest for the newcomer to get to know.

Of course, that's why I have been writing this column. One of my primary goals has been to convert technological gobbledygook into easy-to-understand concepts that leave the newcomer saying, "Oh, that's what it means." Long-time readers may even remember my elementary introduction to RTTY many years back, including the "One if a hamburger, Two for fries" signaling scheme to introduce the digital concept.

New Digital Communications Book

One of the items that I have wanted to see, and would even write if I had the time, is a basic introduction to digital communication. While I have reviewed several books on this subject, few were comprehensive enough to serve as a solid guide to digital circuits. Now, however, I have a new book in my hands that does appear to serve this function admirably.

The book is *Digital Communications With Radio Amateurs*. It really is not a book, but "books," which I will explain later. Although it is subtitled, "The Complete Packet Radio Book," it is a rather complete introduction to conventional RTTY and AMTOR as well.

The first chapter introduces you to the history of digital communication, especially packet, with a tip of the hat to our Canadian neighbors who started the ball rolling in that fascinating mode. Digital mode operating privileges for a given license class, and basic equipment, are also covered.

The next chapter investigates the analog and digital worlds, using many diagrams, some like those in earlier RTTY Loop columns. Analog and digital data, as well as both serial and parallel transmission, are differentiated.

Other possibly troubling concepts are tackled here as well. The author clearly explains simplex, half- and full-duplex modes; data rate transmission in bauds and words per minute; and synchronous and asynchronous transmission schemes. This chapter concludes with some nuts-and-bolts information, including modem use and RS-232 connector wiring. This eighteen-page chapter is all meat, with no fat or other by-products!

Amateur digital communication comes next, with the initial focus on Morse code. Surprised? Morse code is really the first digital mode in amateur radio! Baudot/Murray code, with familiar diagrams of old-fashioned transmitting distributors, complement the pages at this point, followed by descriptions of methods of transmitting RTTY, such as FSK and AFSK. Finally, the book examines ASCII and AMTOR codes, and gives a few simple circuit suggestions for interfacing computers and radios.

Next, the how and why of packet. You will learn every four-letter abbreviation known to the packet world, along with two letters, three letters, and who knows what else. It briefly describes protocols, emphasizing the AX.25 protocol commonly used in amateur circuits.

The TNC—Coming Attraction

Of course, in order to run packet, you will need a terminal node controller (TNC), and that is the topic of the next chapter. You can use your personal computer as a dedicated TNC, along with the more common stand-alone TNC. It examines the functions which take place within the TNC, and lists some of the basic types of machines out there to help you select just what you would like to use.

Once you choose a TNC, this chapter will hold your hand while you connect the device to your computer, and begin attempting to contact another station. It gives a bare-bones interface circuit. It is biased towards AEA equipment, but most commands are standardized, and the information should be of help no matter whose TNC you have.

Not all voice QSOs or packets are simple "Hello, Howdy Do" transmissions. The next chapter details the different operating modes, from keyboard through file transfer to bulletin boards, and explores the differences between VHF and HF packet.

One Network Better Than Two Packets

While two packet stations are nice, a network is better. Chapter Seven shows how the network concept progressed from the early RTTY days to the digipeater of the packet world. LANs, WANs, and GateWays; trunks, datagrams, and wormholes—they are all covered in a thorough, crystal-clear manner.

One chapter takes a detailed look at the question, "Why can't I use my computer to do all the work?" It gives programming ideas and offers solutions. Again, the AEA bias is present, but anyone can use the material.

Chapter Nine covers some "neat stuff" for packet. Whether a program is for the Macintosh computer or a high speed digital modem, this chapter presents some of the latest and greatest for the digital world. The book concludes with amateur satellite communication and tomorrow's technology.

My copy of *Digital Communications With Amateur Radio* is earmarked "Special AEA Edition," with a forward by Mike Lamb, and is available only from AEA or authorized dealers for $9.95. A slightly different version, written by Jim Grubbs, minus Mike's forward and with minor changes, is also available at your local Radio Shack store, catalog number 62-1332, for $6.95.

This book meets the need, which has existed so long, for a widely available introductory text on digital communications. It belongs on every amateur's, and club's, bookshelf.

With the New Year in, let me remind you that I have an index to back issues of RTTY Loop. I try to keep it as up to date as the column, and it is yours for an SASE and postage for two ounces (see above address). Feel free to bug me on CompuServe (ppn 75036,2501) and Delphi (username MARCWA3AJR) as well. I love hearing from you, and some of the questions I have received lately have sent me scurrying back to my texts!

More in store next month, featuring everything that you want to see, right here in RTTY Loop.

"The author (in* Digital Communications With Radio Amateurs*) clearly explains simplex, half- and full-duplex modes; data rate transmission in bauds and words per minute; and synchronous and asynchronous transmission schemes."

Number 24 on your Feedback card

LETTERS

From the Hamsack

Military Net

I would like to get visibility for the amateur radio operators who are on active duty in the US military so we could institute phone patches within the US or overseas areas where authorized. It would also serve to give recently transferred hams a point of contact in their new area. If you're on active duty and would like to be listed, regardless of branch, please write to:

Robert T. Godlewski
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Ft. Lewis WA 98433-5410.

New Ham

This letter is from a person who, until a few weeks ago, was completely ignorant about amateur radio. Now, thanks to your magazine and the book *Amateur Radio, Super Hobby*, by Vince Luciani K2VJ, I am a little smarter.

Though you must write for everyone from beginner to expert, I have enjoyed reading *73*. I even found myself enjoying some of the technical articles I didn't understand!

Mike Sanderson
Janesville CA

RDFing in Chicagoland

RDF has demanded much of my effort for the last 12 of 25 years as a ham. In Chicagoland, there are unsponsored hunts every first and fourth Saturday, attended by a core of dedicated hunters. The second Saturday of each month, the Arlington Communications League sponsors a hunt, and the third Saturday, the Chicago FM Club sponsors a hunt. Once or twice a year on a fifth Saturday, the Greater Chicagoland Foxhunt is run. It pits teams of hunters, usually representing clubs, against one another to find two foxes and win the Trophy. They keep this prize until the next hunt. The Lake County Amateur Radio club of Indiana has been a regular participant, along with the Chicago FM Club.

We would like to involve other organizations in this. RDF does not require an expensive outlay of exotic equipment. Also, it is not a slow and methodical activity, but perhaps the most physical and fastest paced activity in amateur radio.

I have participated in DX contests, sweepstakes, Field Day, public service events, and packet, but for sheer excitement, I find foxhunting to be my favorite. I would like to see a calendar of regularly scheduled hunts published so local and regional contacts can be made. I intend to contact other groups in the country to get information on their hunts and, if possible participate. This will be on a local level, but could conceivably cover a larger area. Vacations would be ideal for hams to take along some of their gear and participate on a hunt in another part of the country—but first, we need to know where and when the hunts are being held. We have to start this before we can have a National Championship.

Mike Brost WA9FTS
Norridge IL 60656

Legalities, Legalities

This refers to the news item about Net-Rom vs Nord Link (Sept. '88 QRX). It is highly likely that in some countries Nord-Link could be charged with violating a copyright. Different countries have different copyright laws, but... Net-Rom is copyrighted under US law.

They say that it is a valid copyright. However, everything connected with packet radio was invented in recent years. So most of the information in their copyright was available from previously copyrighted documents, such as the technical manuals issued with different pieces of equipment. Does Net-Com have releases from all the previously copyrighted material owners giving them the rights to use their copyrights? And where there may be conflicts in the previous copyrights, does Net-Com also have releases from the conflicting copyright owners?

It is impossible to have a copyright in this field that has not used previously copyright items. The words "Packet Radio" were previously used in copyrighted documents. Parts of any circuit must have been previously copyrighted documents. Does anyone have a listing on all this, and releases from all the people involved?

If Nord-Link used this question of whether the Net-Rom copyright is free of any copyright infringement itself, then the courts would probably throw it out.

Paul J. Franzel
New City NY 10956

Tasty 73s

I am a Novice, stationed in Iceland with my family, in the Navy. My mother heard me passing 73s over the air and asked me what "73s" were. When I told her, she said she'd been passing 73s for years, with a product both nutritious and delicious. This ice cream is named "73s" because it contains seven ingredients in proportions of three's, as follows:

3 bananas
3 cups milk
3 lemons, juiced
3 cups heavy cream or
3 pints half and half in place of milk and cream
3 oranges, juiced
3 cups sugar

Mash bananas in blender, add juice of lemons and oranges. Add remaining ingredients and stir well. Freeze. For variety, use other fruits instead of bananas. Serves 8–10 regular people or five amateurs on the air.

Bill Smallwood KB2EHK/TF
Keflavik, Iceland

More Mobile

You asked about my opinion of your magazine. Well, it's the *best* in its field by far. Next, you asked about what I would like to see in your mag. Your coverage of ham radio is far better than the rest, but I would like very much to see articles about mobile operation, mobile antennas, and antennas that are portable and/or can be used in apartments.

I live in California where everyone thinks we have hundred-foot towers and 1500 watts of power on all bands, when in fact we have so many restrictions we're lucky we can operate radio at all. Most people have to live in apartments, condos, or mobile home parks where antennas are not allowed.

I'm sure that you and your staff could cover these topics completely in future magazines. It will probably help your sales, also, which should be tops.

Jerry Delettera N5KKR
California

Thanks very much for your rave comments! Be on the lookout in the April '89 issue for reviews of several mobile and compact basestation antennas for VHF and HF. Also, there are plenty of these reviews in '87 and '88. Refer to the December issues of 73 for the Annual Index of articles and reviews. Failing that, give us a call and we'll look these up for you...

de NS1B

Story of 10-10

Sometime in the 50s, a group of hams got together and started 10-10 International. They required 10 contacts with 10 members as a prerequisite to join the organization. From that point, an individual could upgrade to different awards as he contacted more members. Each contact had to be made on 10 meters. This quickly branched out to local chapters in communities throughout the US and then the world. We are the City of Roses Chapter. To keep activity high, each chapter has awards for contacts with other members on 10 meters.

10-10 International holds a net each week, originating in California, with the intent of upgrading its members and collecting new 10-10 members. Each active local chapter also holds a weekly net for the same purpose. You will find that on any given day, there is a 10-10 net going on somewhere in the country and also throughout the world. Some members have made more than 10,000 10-10 contacts on 10 meters.

With the advent of Novice Enhancement, which for the first time has given voice privileges to Novices on an HF band, we have added a net in the Novice band so that the Novices may join an active group of hams and also join 10-10. 10-10 International and other chapters have done this also. Novices are eligible for any of the awards; there are no restrictions other than the band limitations of their license. All contacts must be made on 10 meters, individually or on nets.

10-10 International has over 50,000 members, and it's growing daily. This camaraderie is probably the single greatest force in preserving this valuable 1.7 MHz bandwidth of the HF spectrum.

Bob McElhatton KF7AK
City of Roses Chapter Head
Boring OR 97009

A SIMPLE LED CHECKER

Get the bad LED out

by Tom Thompson

Have you ever been in a hurry and needed to test an LED for proper operation or polarity? You look for your DVM, and when you find it, you're not quite sure about what to do with it? If you've experienced this, I have something better, faster, and easier to use, and costs less than $5.

Theory

The theory for testing LEDs is quite simple. Apply the proper voltage, limit the current, insure proper polarity, and the LED comes on! The circuit in Figure 1 does this with a minimum of components. When you press S1, the battery supplies the test current to the LED. R1 is a 680Ω resistor that limits the current to just a little over 10 mA with a new battery. This allows good test current throughout the life of the battery.

Construction

The reprint of the label is the actual size. You can use it to determine the proper spacing of the mounting holes for both the switch and the socket. Use an X-acto knife to remove the area inside the two squares where the socket and switch are mounted. Place the label on the plastic box cover and mark the centers of the two cut-out areas. Once this is done, you can remove the label and drill the two holes. S1 is ¼" and the socket is 5/16" in diameter.

Any transistor socket will work. If you substitute, choose the pins you want to use and drill the mounting hole to the appropriate size.

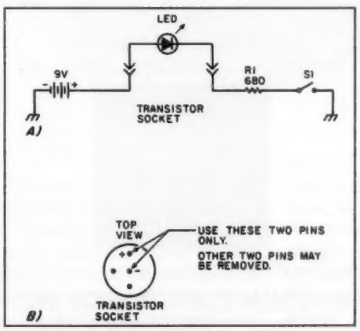


Figure 1. a) The LED Checker schematic. b) Top view of the transistor socket.

Photo A. The LED checker.

The switch is held in place by the mounting hardware that comes with it. The socket is pressure-fit and held in place with a good cement, such as super glue.

Solder the black (−) wire of the battery connector to one side of S1, and solder the red (+) wire to one of the solder contacts on the test socket. Next, solder the 680Ω resistor between the unused connector on the test socket and S1. (Refer to Figure 1.)

A battery compartment spacer is constructed by cutting two pieces of cardboard ⅞" x 2¼" and gluing or taping them together. A small piece is cut off the bottom to allow access to the battery wires (Figure 2).

Cut the label to the correct size and cover the back with rubber cement. This will attach your label securely to the plastic case. Be sure to line up the cut-outs in the label with the socket and S1.

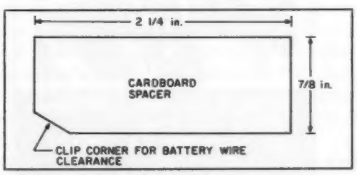


Figure 2. Cardboard spacer. Clip corner for battery wire clearance.

Testing

Insert the LED into the socket and press S1. If the LED does not come on the first time, remove it from the test socket, swap the leads, and reinsert it into the test socket. Press S1 again and the LED will come on. If it doesn't, it's defective. To check your tester after construction, it's a good idea to use an LED you believe is good.

There you have it—a useful item to have in the shack, and a real quickie to put together. Have fun! 73

Parts List

Part	Part #, Description
9 Volt battery clip	RS270-325
9 Volt battery	Standard 9 volt
Switch S1 SPST MOM.	RS 275-1547
Transistor socket	Jim-pak TO-5 Socket, RS 276-548
Plastic case	RS270-221
Resistor R1 680Ω	RS271-021 ½watt
Cardboard spacer (⅞" x 2¼")	See Figure 2

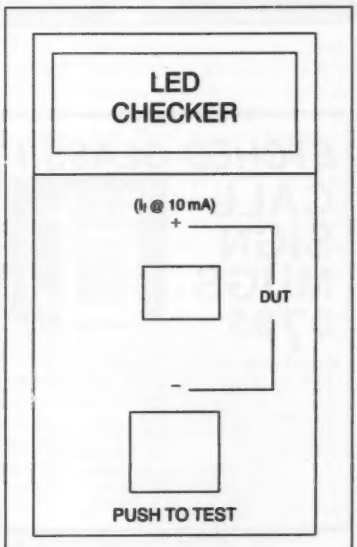
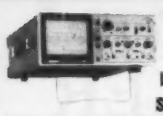


Figure 3. LED Checker label, to cut out.

HITACHI SCOPES AT DISCOUNT PRICES



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V-1065	100MHz	D.T., 2mV sens, Delayed Sweep, CRT Readout, Cursor Meas	$1,895	$1,575	$320
V-1100A	100MHz	D.T., 1mV sens, Delayed Sweep, CRT Readout, DVM, Counter	$2,295	$1,995	$300
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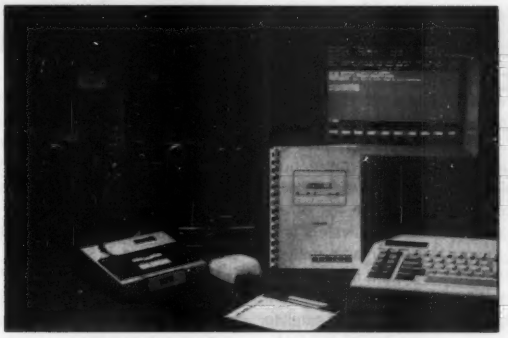


PRODUCT OF THE MONTH

Aries-1™ Software

Ashton ITC announces *Aries-1*™ database software. *Aries-1* unites multi-mode Terminal Units and transceivers with computer interfacing capabilities. It also has a real-time logging function. It lets you display the Logbook and Transceiver status simultaneously, and remains resident in memory while other programs run. In addition, *Aries-1* features a Contest Mode; uploading and downloading files through packet and RTTY; CW speed control; and searching and printing of log data by band, mode, country, and other fields you set up.

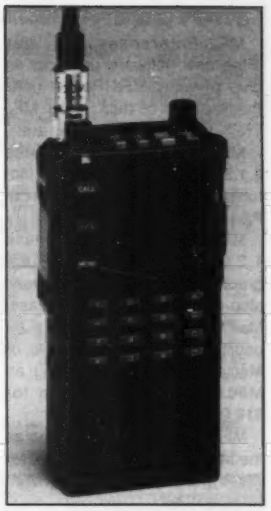
Transceivers currently supported are Kenwood models TS-940S, 440S, 140S, 640S, 711A, and 811A (with appropriate Kenwood IC-10 Kit and IF-232C interface) and ICOM models IC-735, 761, 275, 375, 475, and 575 (with the ICOM CT-17 interface). Terminal units currently supported include the AEA PK-232, Heathkit HK-232. and Kantronics KAM all-mode units.

Aries-1 includes sample message files, a demo-log, and a User's Guide. It is available on 5¼" or 3½" disks, and runs on the IBM and compatibles with at least 256K of memory. Price, $39.95 plus shipping and handling. For further details, contact *Ashton ITC, PO Box 1067, Vestal NY 13851. 607-748-9028.* Circle Reader Service number 201.

ICOM AMERICA, INC.

The IC-12GAT hand-held transceiver from ICOM has wideband coverage from 1240–1300 MHz, 1 W power output, 20 memory channels, programmable scan and memory scan, repeater monitor, and built-in 1750 Hz repeater access tone. It is also splash-resistant for outdoor conditions.

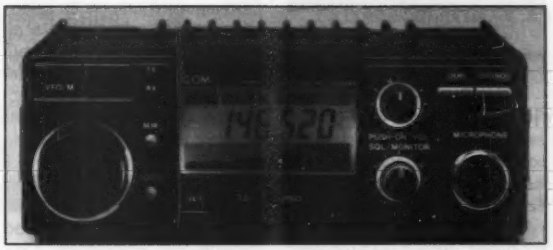
The new "G" series is compatible with all ICOM IC-2AT/IC-02AT battery packs, headsets, and speaker mikes. Optional UT-40 beeper. List price, $529.

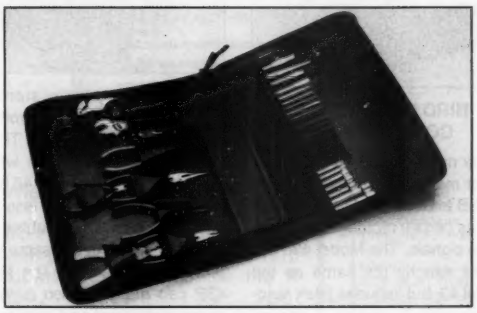


Also from ICOM is the IC-228A 2-meter 25 W mobile rig (the 45 W version is the IC-228H). It features wideband receive 138–174 MHz and transmit 140–150 MHz; multi-color LCD; 20 memory channels with programmable and memory scan capability; priority watch while operating on another frequency; and an optional UT-40 tone squelch unit which acts like a beeper/pager.

This compact unit measures 5.5" W x 2" H x 5.4" D (the IC-228H is 6.2" D). There are 13 front panel controls for easy operation.

Suggested retail prices are $509 for the 25 W IC-228A, and $539 for the IC-228H 45 W version. *ICOM America, Inc., Corporate Headquarters, 2380 116th Ave. N.E., PO Box C-90029, Bellevue WA 98009-9029. 206-454-8155. Telex: 152210. FAX: 206-454-1509.* Circle Reader Service number 202.





COOPERTOOLS™

CooperTools™ offers a new TCS200 soft-sided tool case made of Cordura® leather-like material, designed for the Xcelite® line of tool kits. The kit is available with 10 tools, which include five pliers, a wrench, an electronic snip, a wire stripper-cutter, an electrician's knife, and a curved-nose seizer. In addition, it contains 27 interchangeable screwdriver/nutdriver blades (a selection of slotted, Phillips, and hex) that fit into straight or Tee handles. Price of the tool kit is $447 with tools and $150 without tools. Contact *Xcelite Soft Kit, CooperTools, Box 728, Apex NC 27502.* Circle Reader Service number 203.

HEATH COMPANY

Heath is offering the first kit laptop computer, the HS-2860. It is fully PC and AT compatible. It has a 12 MHz 80286 processor, 1 MB of standard RAM (expandable to 3 MB), and a 1.4 MB 3.5" disk drive (second internal drive, 20 and 40 MB internal hard disks, optional). It can handle spreadsheets, databases, word processing, and a variety of graphics.

Standard features include: 640 x 400 pixel resolution; supertwist LCD screen; removable battery pack providing up to six hours of continuous operation; Expanded Memory Specification (EMS); parallel port; serial port; RGB video port; and an external floppy drive jack. The HS-2860 is 3.07"H x 12.2"W x 15.4"D.

You may order the HS-2860 by calling *1-800-253-0570.* The kit sells for $2,999. The HS-2860 is also available as part of a portable computer workstation with a Brother 9-pin printer, nine-foot parallel cable, and software package. These items are features in the 1988 Heathkit Christmas catalog, which you may order by calling *1-800-44-HEATH,* or by writing *Heath Company, Department 350-038, Benton Harbor MI 49022.* Circle Reader Service number 204.

MFJ ENTERPRISES, INC.

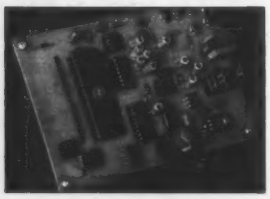
MFJ Enterprises, Inc., has three new software upgrades to give previous MFJ Packet units the features of their latest MFJ TNC units. These upgrades are:

MFJ-40A: Firmware release 1.1.5. Supports basic Packet features for TNCs with 16K RAM. Price, $19.95.

MFJ-40B: Firmware release 1.2.6. 32K with 32K RAM upgrade. Price, $39.95. This release also includes KISS, MFJ Easy-Mail™, and WEFAX receiving capability for the IBM, compatible, or Macintosh computers, using an MFJ Starter Pack option for $19.95.

MFJ-40C: This is the same as the MFJ-40B without the RAM for TNCs that already have 32K RAM. Price, $19.95.

MFJ Enterprises, Inc., PO Box 494, Mississippi State MS 39762. 800-647-1800 or 601-323-5869. Circle Reader Service number 205.

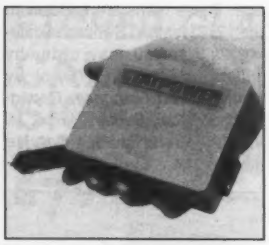


MICRO COMPUTER CONCEPTS

Micro Computer Concepts' RC-1000 Repeater Controller is available from R&L Electronics, complete with manual, schematics, and assembly drawings, for $219.

The RC-1000 is a microprocessor-based (Intel 8751) repeater controller with an autopatch, pulse or DTMF dialing, reverse patch, and control lines for remote base. Contained on a 5.1" x 3.6" PCB are the Mitel 8870 DTMF decoder, audio switching with DTMF muting, six pots for audio adjustments to and from the receiver, transmitter, and phone line.

A relay driver is included for active low PTT and transistor buffered selectable active high or low COS input, 10 jumpers for selecting controller options, and a remote base (interface optional). The RC-1000 has 32 control codes and 10 user codes, all accessible via the repeater receiver or phone line. The on-board rectifier/regulator allows powering of the controller via 12 AC or DC requiring only 200 mA. Wired and tested, the RC-1000 is distributed through *R&L Electronics, 1315 Maple Ave., Hamilton OH 45011. 800-221-7735 or 513-868-6399 in Ohio.* Circle Reader Service number 206.



ATLANTIC SOLAR PRODUCTS, INC.

The Pocket Power Inverter, a 12 V DC to 115 V AC power supply from Atlantic Solar Products, measures 1.2" x 3.5" x 4.5", and weighs 14 oz. Plug it into a cigarette lighter and you have an AC power supply to operate sound and video equipment, electronic test equipment, small appliances, and communications equipment, such as FAX and answering machines. You can also use it to recharge batteries.

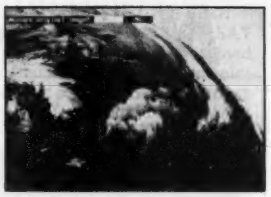
It features an automatic shutdown to prevent overloading and excessive discharge, audible low-battery voltage alarm, 90% extended use of the DC source. The Pocket Power Inverter's operating range is 10–15 V DC with a voltage out of 115 AC 200 Watt surge capability. Price, $149.95.

Atlantic Solar Products, Inc., 9351-J Philadelphia Road, Baltimore MD 21237. Circle Reader Service number 207.

GTI ELECTRONICS and SOFTWORKS, INC.

WeatherTrac™ is a combined hardware/software weather satellite imagery system jointly developed by Softworks, Inc., and GTI Electronics. It combines a 64-level gray scale with a 256,000+ color palette at 640 x 480 resolution (scrollable to 800 lines). WeatherTrac also supports 1024 x 768 mode with a 16-level gray scale and the same palette; plus image "looping," 3-D projection, histogram analysis, and AVHRR radiance calibration for direct read-out of scene equivalent temperatures. VGA+ image analysis tools use a standard mouse interface. Among others, the system captures analog weather satellite imagery from GOES-WEFAX, NOAA/TIROS-N APT (single or dual channel), SOVIET METEOR, METEOSAT, GOES-TAP, and NAFAX (high frequency FM).

The basic WeatherTrac Audio Decoding System includes an external audio interface, an internal acquisition and control card, enhanced VGA+ graphics card, software, and manual, for $3495. The EGA version, without the mouse-driven image analysis tools, and excluding an EGA graphics board, is $1895.



Required are an IBM PC/XT/AT or compatible, a matching graphics monitor, and an appropriate audio front-end (antenna/receiver) for the mode(s) of interest.

Contact *Softworks, Inc., POB 3114, Allentown, PA 18106. 215-395-4441.* Circle Reader Service number 208.

BIRD ELECTRONIC CORPORATION

The new Bird Model 43P Wattmeter measures true peak power of SSB and AM modulated RF, as well as certain rectangular limited pulse signals. The Model 43P operates exactly the same as the Model 43, but includes peak reading circuitry to provide a second operating mode which lets you measure peak power to an 8% F.S. accuracy without affecting the CW measurement capabilities. This circuitry is powered by two 9 V NEDA 1604 batteries with an anticipated life of forty-eight hours in peak mode.

You need no special elements for peak measurements. The 43P uses the full array of the standard Bird plug-in elements. Depending on the element you select, your overall frequency range is 450 kHz to 2.3 GHz, and your RF power range is 100 mW to 10,000 W. The new Bird Model 43P is $279.

For owners of the standard Model 43, Bird offers a Retrofit Kit, Model 4300-400, for $90. The kit includes a PC board which mounts inside the Model 43 housing. Conversion time is less than fifteen minutes. This enables your Model 43 to make the same peak power measurements the Model 43P can make. It also uses the same batteries and meets the same F.S. accuracy.

For more information on the new Bird Model 43P Wattmeter or the Model 4300-400 Retrofit Kit, contact your Bird distributor or *Bird Electronic Corporation, 30303 Aurora Road, Solon OH 44139-2794. 216-248-1200. FAX 216-248-5426.* Circle Reader Service number 209.

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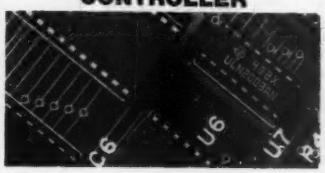

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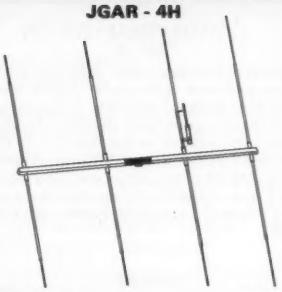

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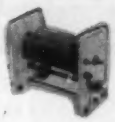

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SOUTH BEND IN
JAN 7

A Hamfest Swap and Shop will be held at Century Center, Downtown off US 33 Oneway North between the Trustcorp Bank Building and the river. Four-lane highways to door from all directions. Tables: $5/5-foot round; $15/8x2.5-foot rectangular; $20/8-foot wall locations. Talk-in on: 6, 52, 99–39, 69–09, 34–94, 145.29. For information, contact *Wayne Werts K9IXU, 1889 Riverside Drive, South Bend IN 46616 or phone (219) 233-5307.*

RIO DE JANEIRO
JAN 7 and JAN 14

The Lions Club International is sponsoring this contest, commemorating the birthday of Melvin Jones, their founder. Their goal is to create and foster a spirit of international understanding and cooperation. Coordinated by the Rio de Janeiro Arpoador Lions Club, the contest is open to all licensed radio operators. Bands permitted are 80, 40, 20, 15 and 10 meters, phone and CW. Phone and CW must be entered into separate logs. Jan 7: CW Mode, starting at 12:00 GMT and continuing for 24 hours. Jan 14: Phone Mode, starting at 12:00 GMT and continuing for 24 hours. For information, write *Hunting Lions in the Air Contest Committee, Rio de Janeiro Arpoador Lions Club, PO Box 2155, Rio de Janeiro 20011, RJ, Brazil, South America.*

MILWAUKEE WI
JAN 14

The 17th Annual Midwinter Swapfest will be held at the Waukesha Co. Expo Center from 8 AM to 3 PM. Directions: I-94 to Co. J, south to FT, west to Expo. Admission: $2 in advance, $3 at the door. Tables (4-foot): $3 in advance, $4 at door. Electrical outlet, as available, $5. Advance deadline is Jan. 2, 1989. Dealers welcome. Amateur exams given (write for details). Food available. Sponsored by the West Allis Radio Amateur Club. For tickets and information, write *WARAC SWAPFEST, PO Box 1072, Milwaukee WI 53201. Enclose SASE.*

JAMAICA NY
JAN 16

The Hall of Science Amateur Radio Club will issue a commemorative certificate to anyone working HOSARC club station WB2JSM, in celebration of their 17th anniversary. SSB operation: 14.335 and 21.365. CW operation: 14.065 and 21.135. All frequencies are plus or minus 15 kHz due to QRM from 1500 to 2100 UTC. QSL with a large SASE (50 cents or 2 IRCs) to *HOSARC QSL Manager Arnie Schiffman WB2YXB, 81-22 250th Street, Bellrose NY 11426.*

HAMMOND LA
JAN 21

The Southeast Louisiana ARC Hamfest will be at the SE Louisiana University Recreation Center. Talk-in on 147.0/46.4. Exams, tables, and fun. Wheelchair accessible. Contact *Joe Farris, 390 Piney Woods, Ponchatoula LA 70454. 504-386-8393.*

SOUTHFIELD MI
JAN 22

The Southfield High School Amateur Radio Club is sponsoring their 23rd Annual Swap and Shop at Southfield High School. Doors open at 6 AM for exhibitors. Open to the public from 8 AM to 3 PM. Admission is $3. Reserved tables are $20 for two 8-foot tables, paid in advance. Additional reserved tables are $10 each. Plenty of parking, food, and door prizes. For information and reservations, contact *Robert Younker, Southfield High School, 24675 Lahser, Southfield MI 48034, 313-746-8637.*

APO SAN FRANCISCO CA
JAN 27

The Kwajalein Amateur Radio Club will operate KX6BU from 0600Z, Jan. 27, to 0600Z, Feb. 6, to commemorate the 45th anniversary of the Battle of Kwajalein and Roi-Namur. Frequencies are SSB: 14.250, 21.350, 28.550; and CW: 7.025, 14.050, 28.050. For $7, KX6BU will send you a QSL, a certificate, and a 64-page book on the Battle of Kwajalein and Roi-Namur. $3 will bring a QSL and certificate. Send requests to *KX6BU, Box 444, APO San Francisco CA 96555-0008*

CRYSTAL RIVER FL
JAN 29

The 9th Annual Citrus County Hamfest, sponsored by the Sky High Amateur Radio Club, will be held at the National Guard Armory, located on Seven Rivers Drive just south of the Crystal River Airport off Route US 19. Talk-in frequency on 146.355/.955. Hourly door prizes, Grand Prize at 2 PM. Packet radio forum, lots of food, and RV parking available. Admission is $3 until Jan 14 (send SASE) and $4 thereafter. XYLs FREE with OM. Swap tables $5. Friday afternoon set-up hours available by pre-arrangement. Doors open at 7 AM for exhibitor set-up, and only admissions purchased with tables will be allowed entry. Open to public at 9 AM. For tickets, tables, and information, contact *Bob Gordon W1KUL, 904-628-5045 or SHARC Hamfest, 5334 S. Forest Terrace, Homosassa FL 32646.*

ST. CATHARINES ONT
FEB 4

The Niagara Peninsula Amateur Radio Club Inc. is holding the 11th Annual Big Event, a hamfest and dinner dance at the C.A.W. Hall, 125 Bunting Road. Admission is $3, tables are $12 each commercial and $5 each non-commercial. Talk-in on 147.24/.84. For information, write *N.P.A.R. Inc., PO Box 692, St. Catharines, Ontario L2R-6Y3, Canada, or phone 416-937-0590.*

MELVILLE LONG ISLAND NY
FEB 5

The Long Island Mobile Amateur Radio Club, Inc., will sponsor a hamfest at the Electricians Hall, 41 Pinelawn Road. Doors open from 9 AM to 3 PM. Admission $4, $3 after 11:30 AM. Sellers' 4' x 6' tables are $12 each, or bring your own at $1.50 a foot, 6-foot minimum. Helpers pay admission. Registration in advance only, check payable to LIMARC. Talk-in on 146.85. L.I.E. Route 495 to Exit 49 North, ¼ mile right turn onto Pinelawn Road. For information, contact *Mark Nadel NK2T, 22 Springtime Lane East, Levittown NY 11756. 516-796-2366, or Hank Wener WB2ALW, 201-694-1811.*

MONTPELIER VT
FEB 4–5

The Central Vermont Amateur Radio Club W1BD is having its 1989 QSO Party on the above dates from 0001Z the 4th to 2400Z the 5th. Suggested frequencies are Phone: 80–15 meters; the first 25 kHz up from the beginning of the General Phone band edge; Novice 10 meter phone portion, 50.110, 144.2; CW: 3540, 3720, 7040, 7120, 14040, 21040, 21140, 28040; and RTTY: 3620 and 90 kHz from lower edge of other bands. For rules on exchanges and scoring, information about awards, and official score and log sheets, send an SASE (two, if you want to receive the results) to *D. Loverin WA1PDN, 50 Liberty Street, Montpelier VT 05602.*

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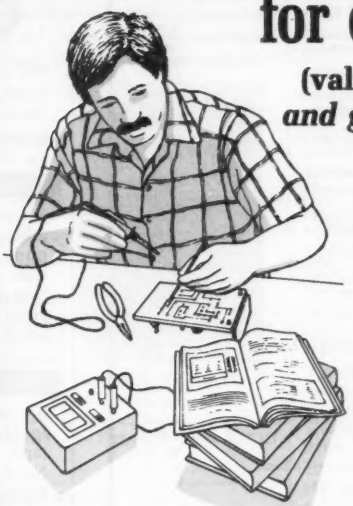

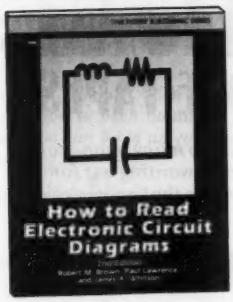

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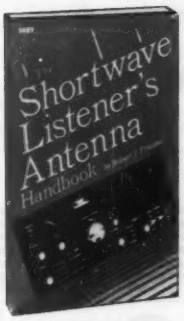

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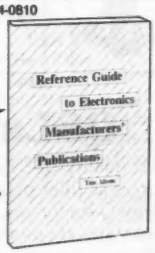

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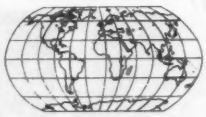

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6	Antenna Suggestions	Dec 77
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11	Radio Shack Realistic Mini 23	Sep 78
12	Hy-Range 681A (Hy-Gain)	Sep 78
13	Kraco KCB-2310B	Oct 78
14	Lafayette Telsat SSB-75	Nov 78
15	Radio Shack Realistic TRC-452	Nov 78
16	CB Walkie-Talkie Conversion	Nov 78
17	Sharp Model CB-800A	Jan 79
18	SBE Sidebander III and Pace 123A	Jan 79
19	Midland 13-882C and Other PLL Rigs	May 79
20	Lafayette SSB-75 and SSB-100	Jun 79
21	Royce I-655	Nov 79
22	Johnson Viking 352	Nov 79
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24	CB to 10 FM - Part II	Feb 80
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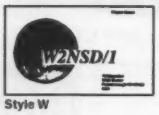

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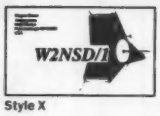

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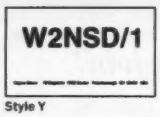

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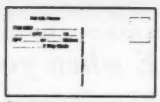
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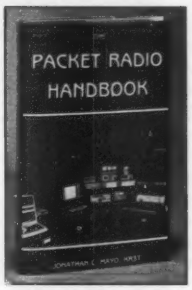

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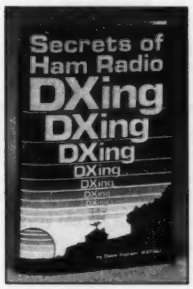

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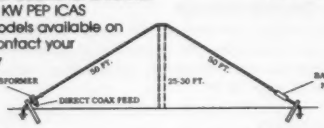

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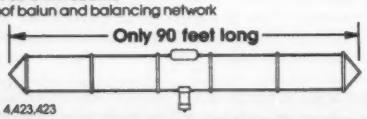

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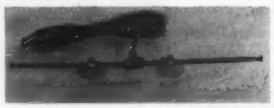

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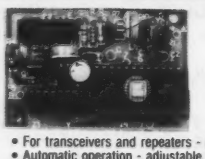

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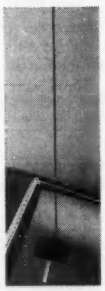

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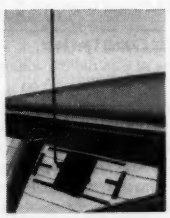

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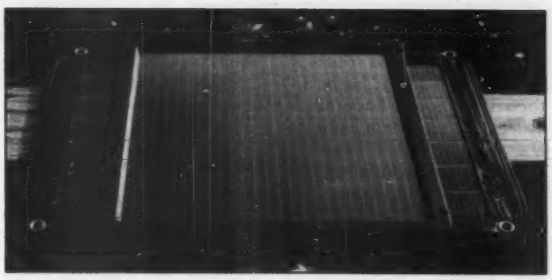

Photo A. These small 5-watt panels operate quite a bit of gear when hitched to a good storage system.

The Captive Electrolyte Battery

Using the proper method, you'd be surprised at the amount of power you can save up in a couple of sunny days. A relatively new innovation in lead-acid battery construction uses a captive electrolyte. The Gel/Cell™ from Globe Battery and the Absolyte™ absorbed-electrolyte battery from GNB Battery Company work about the same as the liquid lead-acid battery, only the electrolyte is jelled. The batteries are then fully enclosed, allowing operation in any position. They will not leak, spill, or emit gas. Of course, some gassing occurs, but special chemicals inside the battery recombine the gas back into the electrolyte. If excessive gas is generated, a special one-way vent allows the gas to escape.

In these gell-cell batteries, you can't add water or take specific gravity readings. They stand up to freezing temperatures without harm. The captive electrolyte concept provides a solution to many of the basic problems inherent in lead-acid batteries, and although these batteries are more expensive per unit of capacity than their liquid-filled counterparts, their advantages often outweigh the cost differential. You should consider them for all photovoltaic applications, especially those in which site access for regular periodic maintenance is impractical.

Batteries for Photovoltaic Energy Storage

Armed with this information, how do you go about choosing the proper battery for PV storage? First, I don't recommend using used batteries, unless you know where they came from and what they where used for. The best method is to use batteries of the same make, type, manufacturer, and age. When the batteries age together, the whole bank will age at the same rate, unless you get a bum battery in your purchase.

One of the strong indications of a battery that it is deep-cycle is its heavy weight. Don't be fooled, however, into buying a large truck battery or Cat™ battery just because it is heavy. All you really get is a heavy starter battery. Truck batteries are not deep-cycle; neither are most Die-Hards™. Since advertising is always a bit less than accurate, be persistent, skeptical, and slow-moving. Because of the weight, purchase your batteries from a local source, unless you can get together with a group and purchase in large lots.

Who makes the best deep-cycle battery? A loaded question, but some of the better manufacturers are: Exide, Trojan, Douglas, and GNB. I use the Exide EV-IV and Exide GC-4. These are designed for electric golf carts. Each battery weighs about sixty-five pounds. The nominal voltage is 6 volts, so you need two batteries for a 12 volt system. The Exide EV-IV and GC-4 are both rated at 220 amp/hr at a 20-hour rate. That means I can draw 11 amps for over 20 hours on each string of two batteries. My system has eight of these batteries, so I can pull about 44 amps from the bank for 20 hours!

Installing and Mounting the Batteries

In a recent test, I loaded the entire storage bank down at 5 amps, and five days later the load was still going. The condition of the battery bank was at a 65% depth of discharge. Since it takes two of the Exide EV-IVs to get a nominal 12 volt system, sixty-five pounds per battery can add up quickly. I have roughly one quarter ton of lead and acid in the basement, not counting the extra six portable 105 amp/hr jobs. Mounting the batteries clearly can become an engineering task!

In my original setup, I used two-by-fours bolted to the cement floor. Over these I placed ¾" external plywood. Then I installed wood runners on the plywood, and onto these I set the batteries. Besides keeping the bottoms of the batteries from sitting right on top of the plywood, the runners provided a path for air exchange between the individual batteries. Lastly, I gave everything several coats of polysealer.

Keep in mind you need two batteries to make up a 12 volt system. You can connect them together with battery connectors like those in your car. I soldered the connection and then used the built-in clamp, making sure not to tighten the bolts too much. The connectors are made of lead, and the bolts can pull through. I used a "flex" size double-"O" multi-strand copper wire for the interconnecting cable. If you can't find such a critter, ask for welder cable at your local welding supply house. You won't need too much for interconnections, so ask for the loose odds and ends.

In designing your storage bank, remember that voltage is additive when batteries are connected in series. Ampere-hour (capacity) is additive when batteries are connected in parallel. You can use almost any type of configuration provided you follow the above requirements concerning battery age, make, etc. You can add more parallel batteries when your pocket book permits. While this may contradict my advice to use batteries of the same age, you can add batteries later as long as you provide enough charge current to the battery bank. The new cells and the old cells will then equalize the charge. It's not a GOOD idea, but you can do it. If you use a lot of energy from your battery system, and your PV array is undersized for maintaining energy storage, it would then be best to replace all the batteries. Otherwise, go ahead and mix the new with the old.

Measuring Battery Charge

No one has yet invented a "fuel" gauge for batteries, and it is not easy or cheap to determine how much "juice" is in your batteries at any instant. All you can do is measure the amp/hr out of the battery system and the amp/hr into the system. But this is expensive and not worth it. There are two other ways of ball-park guessing the battery state-of-charge: measuring specific gravity or terminal voltage.

Measuring Specific Gravity and Terminal Voltage

Let's look at specific gravity first. As you know, a discharging battery will show a drop in the specific gravity when measured with a hydrometer. This reflects the state-of-charge only within these guidelines: The battery electrolyte must be at 80°F, and the battery must have been discharged at the proper amp/hr rate.

A higher than normal discharge rate gives false readings, as does too-high or too-low electrolyte temperatures. At very high rates of discharge, the electrolytes on the plates are weaker than those in the rest of the cell (because they can't mix with the rest of the electrolytes), giving a false and misleading result.

As lead-acid batteries discharge, the drop in specific gravity is quite linear. A plot of the results shows a nice curve. When charging the batteries, however, the specific gravity doesn't return the same linear reading. You have to charge, and charge, and charge some more before the hydrometer starts to show an increase in specific gravity.

Measuring battery terminal voltage is by far the most common method of checking the state-of-charge. The actual battery voltage within each cell of a battery bank varies, depending on whether it is being charged or discharged, and whether it is standing open-circuit (unconnected) or not.

For single cells, the voltage generally ranges from 1.75 to 2.5 volts, with 2.1 volts nominal. So a fully charged six-cell lead-acid battery terminal voltage is 12.6 volts—not 13.8! We can and do float the terminal voltage at 13.0 to 14.5 volts, but the actual battery voltage, after the surface charge is removed, settles down to 12.6 volts. Keep this in mind when running RF gear. Almost all commercial RF transmitters spec their amplifiers at 13.8 volts. Running the same radio from your battery bank will produce a lower RF output. You can really see that one

volt drop, especially in high-power RF equipment. All the same conditions that affect the results in hydrometer readings also raise their ugly heads in terminal voltage measurements, especially a very high charge current.

There's a lot going on with batteries, but I'm not quite done yet! Just as we have learned that batteries come in different voltages and capacities, they also come in different percentages of acid. We have 1300, 1280, and 1265 batteries. If your local friendly battery person asks you which kind you want, tell him 1280. What do these numbers tell? They indicate the full charge specific gravity acid concentration.

A fully charged 1300 battery reads 1.300 on the hydrometer. Likewise, a fully charged 1280 shows 1.280 on the hydrometer. Golf cart batteries and your Exide HC-27-106 battery are 1280 batteries. All the very large batteries built for heavy industrial use are 1300 batteries, as are the batteries for electric personal carriers, tow motors, and floor sweepers. The batteries your local phone company uses are 1265, which have a life of over 25 years. The lower concentration of electrolytic acid will not eat away at the insides as fast as a higher one would.

Last Word on Battery Testing

How do you test a battery to find out if it is up to par? Charge it up and then discharge it at the recommended rate. Next, plot the results to find out if the battery can deliver its rated capacity. This is not practical for most of us, especially in measuring a large battery bank. At many larger battery shops, they use a load meter to check each battery they sell. It's simple to use. You load the battery down at three times the total amp/hr rating of the battery for 15 seconds. A good battery will hold its terminal voltage to at least 9.6 volts. For example, to test one 6 volt Exide battery, load the battery at 660 amperes for 15 seconds. The battery must hold its terminal voltage at 4.8 volts (half the required 12 volt rating) to pass..

Working with your own energy production is a fulfilling pastime. Checking battery fluids, cleaning and checking cables, and removing accumulated dust and debris becomes routine.

Taking Precautions

When working around batteries, you must be aware of the danger, as deadly as it is silent, of voltage. While most of us use a nominal system voltage of 12 volts, some of you may use higher battery systems of up to 140 volts DC. It's easy to become careless, especially if your system is 12 volts, and I know of no one who has been zapped with 12 volts. But imagine—you're wearing a ring, get it across two terminals, and 1000 amps of current flow through it. Instant meltdown! You lose a finger!

Gas is another major danger. Because of gassing, you must provide adequate ventilation for the storage room. Besides the unpleasantness of the "dry throat" you get from the presence of free hydrogen, there's always the excitement of the Hindenburg effect: it only takes 4% hydrogen and one match to demonstrate it. If you don't have tight connections at the battery terminals, or if you drop a wrench between the posts, you don't even need the match! Even if only one battery, instead of the whole bank, explodes, you've still got a good chance of getting a cardiac arrest from the shotgun noise at close quarters, or some nasty burns from sprayed acid.

Carelessness and batteries don't mix—not quietly, that is. For goodness' sakes, use an eye shield—battery acid is the third major danger.

Let's See Those Pix!

I still have not received any photographs of QRPer shacks. Looks like I'll have to be the first and use one of my shacks. That means I'll have to clean it up first! I'll be reprinting the HW-8 handbook. I'm still looking for mods for the HW-8 and the newer HW-9, and I hope to have the books done by the spring of '89.

Next month I'll have a lot of odd and ends to distract you from the cold. Miss one month and you'll miss a lot. Slow that electric meter down, go QRP! 73

Number 28 on your Feedback card

HAM HELP

Your Bulletin Board

We are happy to provide Ham Help listings free, on a space-available basis. To make our job easier and to insure your listing is correct, please type or print your request clearly on a full (8½" x 11") sheet of paper. Double-space and use upper and lower case letters where appropriate. Also, write numbers carefully—a 1, for example, can be read as an l or an i or a 7 as a 1. Thanks for your cooperation.

Need schematic, etc., for Delco 30BCTS1 from Sam's AR-339. Will pay postage and copying costs.

Lisle T. Hines K2QLA
11 Meadow Drive
Homer NY 13077

Wanted: Manual and schematic for KLM Linear Amplifier, Model No. 30-140B. Will gladly pay copying and mailing costs.

Edward Moiser N8IOV
4376 Coolidge Road
Coleman MI 48618

I am looking for the following items (please state price and/or condition in correspondence): Two MRF-455 A transistors; MFJ-962, -949C, -941D, or 989 antenna tuner; five 7868 tubes; ten #12 6-V lamps for Bogen PA Amps; one bandswitch each for the Panasonic RF 2800 receiver #RSR 98W or equivalent; one printer and disk drive for the Tandy Color Computer II Model 26-3127; and one Z-80/CPM and Modem Board for the Apple IIe Pro System.

Mike Adams
Haney Vo-Tech Center
3016 Hwy 77
Panama City FL 32405

I'm looking for manuals and/or schematics for a Heathkit model GR-91 receiver. I'll gladly pay for any costs incurred.

Darrel L. Daley KL7DN
Radio Free Vermont
P.O. Box 445
Putney VT 05346

Does anyone know where I might purchase a new or used TK-1/BC-1 memory backup power supply for my Kenwood TR-7800? It is a small AC adapter that plugs into a wall outlet and retains the memory frequencies in the TR-7800. Thank you.

Michael A. Horn
516 Union Place
Fremont OH 43420

I would like to hear from anyone who uses the Tandy Model 100 and 200 for amateur radio. I am interested in any programs, especially satellite tracking.

Scott Harvey KA7FVV
2517 N. Calispel
Spokane WA 99205

Gentlemen: I just "inherited" an *old* Gonset Communicator II, 2 meter AM transceiver! Someone removed the mike jack and didn't sketch the location of the wires. I need a schematic for this unit. If you have one, I'd be glad to pay for copying and mailing costs. Thanks for helping me get this old rig back on the air!

Bert Voth WA0PWE
802 Forest Drive
Olathe KS 66061

Wanted: Machine language program for the TRS-80, model 1, level 1 or 2 (prefer level 1) to TX/RX RTTY via expansion port. Will pay nominal fee.

Frank Brinson
5113 Richland Ave.
Chillicothe IL 61523

I need a schematic for Swan 350B and schematic/manual for Swan HF 700S transceiver. Will pay for any charges. Thanks.

Charlie Wallace
Rt. 3, Box 223K
Big Pine Key FL 33043

I need a service manual or at least a schematic for an Edgecom System 3000A VHF FM 2 meter transceiver. I will pay for copying or other costs.

Chuck Crowley K5BER
215 Clower Ave.
Long Beach, MS 39560

I need a diagram and part values for my ailing Hickock Teaching Aids Scope, Model OSK-4, and will be glad to reimburse someone for copying costs and postage.

Paul Hinkamp W8YOU
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Midland, MI 48640

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D SIZE $4.50 each
1.2 volts 1200 mAh
CAT# NCB-D

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PN2222	NPN	TO-92	5 for 75¢
2N2904	PNP	TO-5	3 for $1.00
2N2906	PNP	TO-18	3 for $1.00
PN2907	PNP	TO-92	5 for 75¢
2N3055	NPN	TO-3	$1.00 each
PN3569	NPN	TO-92	5 for 90¢
2N3904	NPN	TO-92	5 for 75¢
2N3906	PNP	TO-92	5 for 75¢
2N4400	NPN	TO-92	5 for 75¢
2N4402	PNP	TO-92	5 for 75¢
2N5400	PNP	TO-92	4 for $1.00
2N5680	PNP	TO-3	$2.00 each
2N5882	NPN	TO-3	$2.00 each
MJ2955	PNP	TO-3	$1.50 each
MJE2955T	PNP	TO-220	75¢ each
MJE3055T	NPN	TO-220	75¢ each
TIP30	PNP	TO-220	75¢ each
TIP31	NPN	TO-220	75¢ each
TIP32	PNP	TO-220	75¢ each
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Two place holder.
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Nominations are requested for "Radio Amateur of the Year," "Special Achievement" and "Technical Achievement" awards. Contact: Hamvention Awards Chairman, Box 964, Dayton, OH 45401.

License Exams
Novice thru Extra exams scheduled Saturday and Sunday by appointment only. Send FCC form 610 (Aug. 1985 or later) - with requested elements shown at top of form, copy of present license and check for prevailing ARRL rates (payable to ARRL/VEC) to: Exam Registration, 8830 Windbluff Point, Dayton, OH 45458

1989 Deadlines
Award Nominations: March 15
Lodging: April 7
License Exams: March 26
Advance Registration and banquet:
USA - April 4 Canada - March 31
Flea Market Space:
Spaces will be allocated by the Hamvention committee from all orders recieved prior to February 1. Express Mail *NOT* be necessary! Notification of space assignment will be mailed by March 15, 1989.

Information
General Information: (513) 433-7720
or, Box 2205, Dayton, OH 45401
Lodging Information: (513) 223-2612
(No Reservations By Phone)

Lodging
Please write to **Lodging, Dayton Hamvention, Chamber Plaza, 5th & Main Streets, Dayton, OH 45402** or refer to our 1988 Hamvention program for lodging information which includes a listing of hotel/motels located in the surrounding areas of Dayton. Reservations for the surrounding area will then become the responsibility of the individual.

HAMVENTION is sponsored by the Dayton Amateur Radio Association Inc.

Advance Registration Form

Dayton Hamvention 1989
Reservation Deadline – USA-April 4, Canada-March 31
Flea Market Reservation Deadline: February 1

Enclose check or money order for amount indicated and send a self addressed stamped envelope.

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Flea Market (Max. 3 spaces)	_____	$25/1 space $50/2 adjacent $150/3 adjacent	$_____
Admission ticket must be ordered with flea market tickets		**Total**	$_____

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HOMING IN

Radio Direction Finding

Joe Moell PE K0OV
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Quads And Yagis: The Winners' Choices

Here in Southern California, all but one of our monthly hunts are on the 146 or 220 MHz bands, and almost all competitors use a small beam, either a quad or a yagi, as the primary radio direction finding (RDF) antenna. The mast either goes through the window and is fastened to the door handle with some sort of bearing lash-up, or there's a hole in the roof with a thrust bearing and a compass rose at the bottom of the mast.

Why would anyone choose such an unwieldy RDF setup? After all, it's large and cumbersome compared to loops, L-Pers, SuperDFs, Dopplers, and other available schemes. The answer, as we'll see, is that it's a simple but very effective solution to a number of RDF problems.

Beam hunting is so simple that you may already have everything you need to get started: a quad or yagi antenna, a receiver with an S-meter, and an attenuator to knock down strong signals. (More on attenuators in a future column.)

Intuitively, you've probably guessed that the way to hunt with this setup is to swing the beam around until the hider's signal peaks on the meter. Then drive in the direction that the beam points. It's almost that simple, which is one reason why beam hunting is so popular. The S-meter will bounce around with the usual mobile flutter as you whiz down the road, but with a little practice you'll find it easy to take bearings on the fly, using "eyeball integration" of the meter reading.

The hilly terrain and large boundaries of southern California hunts make a high gain antenna system a necessity. Starting points are on hilltops, and as often as not the hider is dozens of miles away running a couple of watts from a canyon or river bed. It's important to keep hearing the signal after coming off the hilltop, if it's at all possible. There is nothing more frustrating than having to continue to go in the direction from which the signal was last heard, hoping to catch some signal again soon. After all, the idea is to hunt down the signal, not to hunt for the signal.

A 4-element optimum-spaced quad has a gain of around 10 dB. Other popular RDF antenna systems for the 100 to 500 MHz range have no gain, and may even be quite lossy. You can make the sensitivity of your beam hunting setup even greater by adding a low-noise preamp in the antenna line.

Beams Shine in Multipath

Last month I pointed out that VHF RDF is much more difficult when the signal is bounced around by nearby and distant features of the terrain. The signal may arrive at the hunter's location from more than one direction, via more than one path. Sorting out the direct and reflected bearings takes good equipment and lots of practice.

In a severe multipath situation, a sharp beam provides more information than a Doppler or other RDF system. As you rotate your beam around a full 360 degree turn, each of the apparent signal sources gives a peak on the S-meter. You can mark all these directions on your map for comparison with previous and future bearings along the way. (You do have good maps, don't you?)

Your S-meter will tell which of the signal sources is strongest. Usually that's the direct signal, and smaller peaks are reflections, but there are enough exceptions to that rule to make for some really tough hunts.

Photo A. A yagi—an excellent starter antenna for RDFing.

Select Your Polarization

If you've experimented with OSCAR satellites, you know how important it is for transmitting and receiving antennas to have the same polarization. It's every bit as important in T-hunting. On most hunts, the hider is free to select any polarization, so hunters must be prepared.

Incorrect polarization of your RDF antenna not only diminishes the level of the direct signal, it also increases the relative level of unwanted multipath. That's because when the signal bounces, the polarization often shifts. If the fox is horizontally polarized and your RDF antenna is vertical, you'll lose 10 to 20 dB system gain for directly received signals. You'll have less loss than that for reflections, because some scattered back signal components will be near vertical. The net effect is to accentuate the reflections.

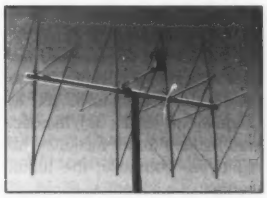

Photo B. The wire-quad antenna.

The ability to select polarization is an important reason why beams are the most popular VHF RDF antenna. The antennas in the photos are oriented for vertical polarization, but are designed so that they can be readily changed to horizontal (or angles in between). Smart hunters always check polarization at the beginning of the hunt, then check again later on in a clear signal area while closing in. Many other RDF systems, including Dopplers, have only vertically polarized antenna elements.

Quad or Yagi?

What kind of beam is best for two meter RDF? Is a quad better than a yagi? Many hams think so, though each type is commonly used. A quad is half as tall as a same-band vertically polarized yagi. This can either give lower profile on the vehicle, or allow a higher center of radiation for the same maximum height—take your choice.

Proximity to the vehicle roof affects performance of a quad less than a yagi. Best of all, a quad has about two dB more gain than a yagi for the same boom length. Clearly, the performance of a lightweight quad makes it worth the effort to build it.

Quad elements don't have to be diamond-shaped like the ones in Photo B. You can make the sides parallel and perpendicular to the car top (box configuration) for a lower profile, if you feed the driven element properly for the desired polarization. You could also make the elements triangular (delta quad) or even circular. Local hunters have used all of these types successfully. The circumferences of the elements remain the same fractional wavelengths, no matter what the shape.

While some other RDF systems require a carrier-type signal to work properly, a beam/receiver setup will get bearings on any signal that the receiver can detect. AM, FM, SSB, CW—no matter. Just rotate the antenna and peak up the S-meter or listen for the cleanest, strongest signal.

Want to hunt ATV? Simply aim the beam for the least snow and fewest ghosts. What about pulsed noise sources? Peak them up on the meter or by ear using the receiver's AM or SSB mode.

Radon Gas?

So what do you tell those passers-by who ask if you're using that big antenna to watch the ball game? I've been tempted to say that it's a setup for searching out radon gas levels, and I'd be happy to check out their houses for a small fee!

Actually, such encounters are an excellent way to get good PR for our hobby. Anyone who is interested enough to ask will probably be interested in hearing about ham RDF and the public service it can provide. If the ham turns the inquirer away with a flip answer, he'll just reinforce the "hams are weird nerds" stereotype.

On the other hand, I know there's no time to explain the finer points of transmitter hunting to a stranger while you're on a timed hunt. So I came up with an information sheet on T-hunting and ham radio that you can give to curious onlookers, and let you get on with your hunt. I'll be glad to send you one (then you can make your own copies), if you'll send me an SASE. While you're at it, tell me about the hunts in your town.

Next month this column will feature more on beam hunting, including plans for building a popular hunting quad. 73

Continued from page 8

has a tremendous lot to offer America. Indeed, with technology being the future and with consumer electronics being the engine that drives technology—and the real power behind the Japanese miracle—we have no other practical plan for regaining our technological superiority other than through a reborn American amateur radio community.

It's a big responsibility and we're only 200,000, so there's no room for anyone to beg off. You're not too busy. You're not too short of money. You're not too old. Every one of our 200,000 active hams needs to accept the responsibility to make a difference. When one single person can make a difference, imagine what 200,000 can do!

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Less than half of the active hams are reading *73*. I need your help to get 100% of them reading *73*. What can I do to get 'em? YOU tell me. I don't ask that *73* make money, only that it doesn't lose so much that it goes out of business. You can help by finding out why your ham friends are not reading *73* and letting me know. Do I need to change *73*? The previous owners tried cutting my editorials and that wasn't the answer. Please start asking and then drop me a note. Is *73* boring? Yes, of course I want to publish more construction projects—and we've got some coming. But finding 'em these days is tough. I may have to have them translated from the Japanese ham magazines, since they're doing most of the building today.

If we had more advertising we'd have a fatter magazine—the way it used to be ten years ago. Ask the advertisers why they are not advertising in *73*. I know that those who are, tell me their ads sell their products for them. Getting people to change isn't easy—and that includes non-advertisers as well as non-readers.

If any of you are involved with your educational systems in your states, I'd love to have you arrange for me to talk with the decision makers about instituting an eight-year course in the fundamentals of electronics, communications and computers—grades 5–12. Every youngster in America should take such a course—and it should be fun. I've got a way, as I've written several times, to provide it so that there isn't any need to train science teachers first. It's a sneaky approach that I believe can bring us tens to hundreds of thousands of new hams a year. We could use 'em. I haven't found any educators who don't believe my system will work—and I've discussed it with over thirty college presidents so far.

Now, those pesky parents—I've a plan for getting them onto their kids' cases too. This involves producing some videos to help parents come to grips with their responsibilities as parents. You haven't even seen a PBS program covering this problem—and it needs the impact of a video.

The average father talks with his children less than 15 minutes a day. We see what a fantastic difference parental involvement makes with our new Asian families, where their kids are running circles around American kids. We need some videos to help parents work with their kids and to motivate them. Such a series should make a bundle. Anyone want to work with me on the project?

You might note that none of my proposed solutions involve any heavy government investment. No spending. To the contrary, my proposals will end up saving the government billions. This could go toward reducing the deficit, but being practical about that I expect that as soon as a billion is saved that liberal congressmen will find at least two ways to spend every dollar saved.

I believe that tens of billions in military and government expenses could be saved, if we set up a federal commission to protect whistle-blowers. Virtually every government and military ham I meet has a long list of horror stories of flagrant waste, but they don't dare say anything about it or they're washed up. And why bother if the billions saved will just be thrown into some other stupid government project or given to some dictator to keep in Switzerland for his retirement?

So let's work toward rescuing amateur radio—toward a temporary block on further frequency losses—toward rebuilding our school radio club infrastructure. If we can get the 200,000 active hams all reading *73*, perhaps we can make all this happen. Do you know any other approach that has even a slight chance of working? 73

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ABOVE AND BEYOND

VHF and UHF Operation

Pete Putman KT2B
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QTH K2OWR

As I write, the fall tropo season is well underway, and the September VHF Contest is a pleasant memory. Although conditions were not as good as expected, our multi-operator group still had a great time, and even got a few licks in during the Sunday aurora session on 6, 2, and 220.

Understandably, most of the SCORE members were a bit weary after the ambitious Chincoteague trip in June! Disassembling and reassembling your station every few months is a lot of work and gets to be a bit tedious. However, a few of the gang decided to have a "low-key" effort from Bill Radice K2OWR's QTH in the hills of northwestern New Jersey, using the long-dormant K2XR callsign.

Only Bill, Ivars KC2PX, and I were present from the June operation. Jerry Meckenberg K2JWE agreed to put in a few hours, and we recruited three new operators from the local area—Leroy KA2UHS, Harry N2GUF, and Bill KB2ENE. None had any practical VHF/UHF contesting experience, but all turned in a first-class job with a little bit of encouragement.

Bill's house is in an enviable location, sitting near the top of a long ridge 1,000 feet in elevation that forms the northern side of the Pequest River valley. It's a rural, scenic location, with great views in every direction except west by southwest. Bill designed his own modular house and (with great difficulty) managed to get all the pieces in place at the edge of a steep cliff. It was just a matter of time before two towers sprang up, just up the hill, topping out at 70 and 50 feet, carrying a full load of yagis for 50, 144, 432, and 1296 MHz.

Most of the antennas and one tower trailer from Chincoteague wound up in Bill's yard. It was a simple matter to round up the other trailer, plus additional yagis from Ivars, and our "low-key" effort shifted into high gear rather quickly. The band complement expanded to include everything from 50 MHz through 2304 MHz, with dedicated stations on each band scattered throughout the house, and even down the hill in a mobile camper.

Murphy Strikes

Murphy hit us hard the Friday before the contest. I had spent over an hour repairing the direction indicator in a CDR CD-45 rotor, and installed it atop the W-67 crank-up to support 2 x 19 yagis on 220, 4 x 25 yagis on 2304, and 4 x 23 yagis on 903.

Photo A. Putting together the 220/903/2304 station.

All went well until the tilt cable—that everyone was "going to get around to replacing someday"—snapped with the tower at about 45 degrees. Our microwave hopes nearly went up in smoke with a thunderous crash, as the tower dropped back into its cradle and (A) smashed two of the 2304 antennas beyond recognition; (B) severely bent several elements on the 220 yagis; (C) snapped four elements clean off the 903 array; and (D) completely flattened a 5-foot aluminum ladder.

To make matters worse, the impact sheared the base of the CD-45 completely off the rotor, cracking the bottom casing in half and stripping two bolt threads—an hour's work completely wasted. Leroy, Bill, and I just stood there in shock for about five minutes. It was amazing that none of us was lying prone on the ground waiting for the rescue squad!

No sense feeling sorry for ourselves. I pulled out my portable machine-shop-in-a-toolbox and began repairing the 2304 yagis, that were ready for the scrap heap. Leroy set about removing the other yagis so the mast could be extracted, and Bill made sure the heroic ladder got a decent burial for its valiant efforts under attack.

The W-51 trailer had originally been intended to carry the 4 x 17 element 2 meter array that proved so successful at Chincoteague, but our near disaster quickly changed those plans. Believe it or not, we were able to repair all of the antennas and reinstall everything atop the W-51 in just under two hours, snatching a victory of sorts from the jaws of defeat. Just for laughs, we added a single 7-element yagi for 440 MHz FM before the W-51 was cranked up—this time with no sudden surprises from Mr. Murphy!

Loaded for Bear

The station complement was competitive: 1 kW to a Hy-Gain 8-element yagi atop the 50-foot tower on 6; 1 kW to 19 elements at 70 feet on 2; 600 watts to the 2 x 19 array at 60 feet on 220; and 2 x 22 elements with 700 watts on 432 at 70 feet. In addition, we ran 20 watts to 92 elements on 903; 60 watts to 92 elements on 1296; and finally, 8 watts to 100 elements (give or take a few) on 2304. We were truly loaded for bear!

I printed up a few explanatory sheets to give our three new operators a quick introduction to the world of grid chasing, including the principles of making schedules on other bands to boost the overall grid count. Boy, did they pick that up quickly! As the contest evolved, Bill's QTH resembled a firehouse with operators constantly running between 2/432/1296 upstairs and 220/903/2304 downstairs with little slips of paper. I suggested turning a spare mast into a fireman's pole to save time. (The suggestion was promptly ignored.)

The 6 meter stalwarts were about a hundred feet down the road, ensconced in Bill's comfy camper and connected to the "firehouse" by an intercom system. Some of the guys preferred to sprint down the road to the trailer with sked information for exercise. This system worked! Our own record was working W9IP/2 from FN24 on four different bands within the space of five minutes, using both the intercom and "winged messenger" systems.

Conditions and activity levels were fairly typical for September. Plenty of grid squares were active, but the number of signals was down considerably from June. Tropo conditions were mediocre at best, except for an occasional "ping" from the Midwest, such as a contact we made on 432 into EN72 (southern Michigan) that came as a bolt out of the blue. The number of stations we had to operate made up for the activity levels, as we spent considerable time making long-haul contacts on 903, 1296 and 2304.

Help from the Aurora

Finally, it came, as the old-timers say it always does—an aurora. At first it was just a whisper here and there on 2 meters, then a crescendo of raspy CW signals burst from the noise, signing 8, 9, and even 0 prefixes. The chase was on! Since we had some "hashing" on 2 meters from the 220 station, we decided to stay on 6 and 2 only for the duration of the contest. And a good move it was, as our first 31 contacts during the aurora on 2 yielded 21 new grid squares—even ten in a row at one point!

Six meters was even crazier, working as far west as EN34 in western Wisconsin. But there was plenty of activity to the north and northeast, as we made contacts in

Continued on page 102

73 Review *by Pete Putman KT2B*

Coaxial Dynamics Model 81000-A Directional RF Wattmeter

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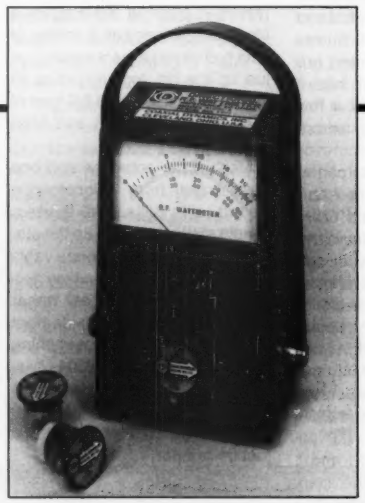

The Coaxial Dynamics Model 81000-A. Note the large, easy-to-read meter scale.

There's no question that an accurate RF wattmeter can be one of the more useful test instruments in your shack. With it, you can measure forward and reflected power, transmission line loss, and VSWR of antennas and coaxial lines. You can find many varieties of wattmeters in the marketplace, but by far the most accurate are those using directional couplers. To make such a meter usable at any frequency, the detecting element should couple to a section of transmission line of, ideally, 50Ω. This would allow insertion in virtually any section of a 50Ω line without affecting the impedance of that line.

Great idea, and it has already been done. (Do thoughts of a winged creature flying about Cleveland, Ohio, suddenly cross your mind?) For many years the industry standard for 50Ω thruline directional-coupler wattmeters has been the Bird Model 43. You can find them everywhere in a variety of applications. Owners of clean used Model 43s often sell them used for more than they paid for them! This phenomenon is due largely to two factors: (1) Bird's almost annual price increases and (2) the virtual absence of competition.

New Kid in Town

Well, hold on to your hats. Coaxial Dynamics, also of Cleveland, produces the Model 81000-A inline directional-coupler wattmeter that works just as well as a Model 43. The design of this instrument is essentially identical to the Model 43: a 50Ω transmission line section runs through the shell. A rotatable diode coupler/detector element is inserted into a socket coupled at the midpoint of the line section. You can rotate it 180 degrees for reading forward or reflected power.

Many different elements are available to cover the 2–1300 MHz range, with power levels from 100 milliwatts to 10 kilowatts (yes—10,000 watts), using various Quick Match connectors. Coaxial Dynamics also makes special elements for use with larger line sections, such as 1⅜" and 3⅛" hard-line. And here's the kicker: All Coaxial Dynamics plug-in elements are fully interchangeable with Model 43 elements. This means that if you already own a Model 43 or two, your existing elements will fit the 81000-A . . . and its elements will drop into your Model 43 nicely. Clever!

There are other similarities between the two lines. One of these is the grouping of elements by power and frequency range (Bird lists them as "Table XX Elements;" Coaxial Dynamics as "Schedule XX Elements"), and the many different kinds of connector options (Bird calls theirs "Quick Change," Coaxial Dynamics "Quick Match").

Not a Clone

Is the Model 81000-A a Bird "clone?" Not entirely. For one thing, the meter scale is considerably larger. Next, the surface contains a small mirror band to make readings easier. On the other hand, the movement is 30 microamperes full scale, like the 43 (the elements otherwise couldn't be swapped). The housing is about 10% larger than the 43, and the front panel slopes backwards from bottom to top, which allows more ambient light to fall on the meter scale. Also, the 81000-A carries two spare elements on the rear panel, as opposed to the sides.

The elements are also similar, being identical in size but different in case markings and colors. One disadvantage of the Coaxial Dynamics elements is their identification system; a five-digit code refers to one of the three Schedules. This is more of a serial code than an identifying mark. For example, a Bird 250 watt 50–125 MHz slug is called a 250B, whereas the same slug in the Coaxial Dynamics line is called an 82025.

How well does it work? Very well. In fact, I was unable to detect any differences between a late-model 43 and the 81000 using both brands of slugs on 50, 144, 432, and 903 MHz. Measurements were made at 10, 25, 100, and 250 watt levels. I didn't bother to print the data simply because there was no significant variation at any power level.

I did check for insertion loss at 1296 MHz using a 25 watt coaxial resistor. With 25 watts of RF from an LT-23S through a short piece of 9913, I connected the 81000-A at the end of the line and installed a Termaline load at the other port of the 81000-A. I measured no reflected power, so insertion loss is certainly better than 1.05:1, as the owner's manual claims.

Verdict

The burning question is: Why should you buy a Model 81000-A instead of a Model 43? Two possible answers are that: (1) You prefer the color blue to gray, or (2) You'd like to save about $20 on the meter and from $2–$6 on the more common elements. If you plan on picking up a wattmeter with 3 elements–say, one for HF and 2 for VHF–you'll wind up pocketing about $30 over a comparably-equipped Bird Model 43. This price difference may or may not be offset by other factors, such as customer support. The 81000-A, however, will do the job every bit as well. 73

Coaxial Dynamics Model 81000-A RF Wattmeter Specifications

Power Rating	Depends on element used
Impedance	50Ω nominal
Insertion VSWR	1.05:1 max. with "N" connector
Weight	3.6 lbs.
Element weight	3 oz.
Accuracy	5% of full scale
Size	5" W x 7¼" H x 4" D

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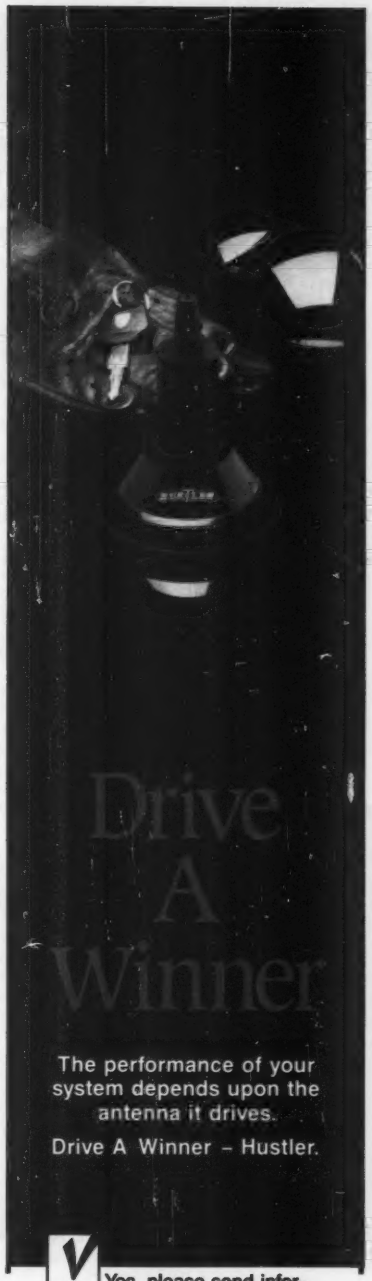

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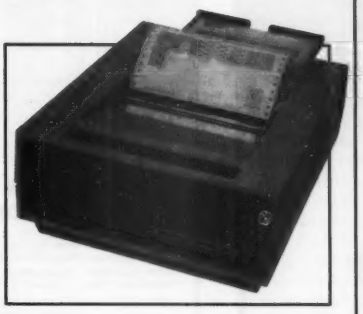

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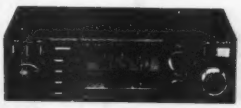

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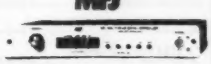

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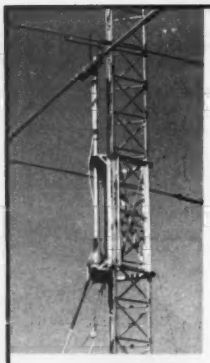

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INDEX: January

Issue #340

Number 33 on your Feedback card

10-10 60
10 GHz 12
220 MHz 9, 18–22, 24
2 meter injector 13
7400 quad NAND gate 35
7473 dual J-K flip-flop 35
1N23 diode 12
2N2222 transistor 12
2N3866 22
AEA FSTV-430 53
AMSAT-OSCAR 91
Atlas 11
attenuator 14
AutoSketch 30
bandwidth 94
battery testing 71–72
Bird Model 4381 32
boomerang/backfire antenna 12
callsign software 46
coil tapping 24
Commodore 64 40–41
contest, home-brew 9
coordination, repeater 11
digital communications book 59
Exide batteries 71–72
filters 94
graphics software 30
Hamcall 46
horn antenna 12
KØOV, Joe Moell 77
K3OF, W.C. Cloninger, Jr. 14
KC3YB, John R. Somers 58
Kenwood TS-940S 18, 20, 24
KT2B, Pete Putman 79
microwave 12–13
Mir 9
N4RVE, Steve Roberts 44
networking 59, 60
NR1A, Douglas Stivison 54
oscillator, audio 29
packet 59
power supplies 40–41, 50–51, 71
propagation 92
quad antenna 77
RDF 60, 77
RS 270-326 battery holder 35
RS 276-150 board 35
RS 279-355 jack 36
satellites 91
short wave manual 54
solar power storage 71
spectrum analyzer 44–45
troubleshooting 50–51, 58
VE1VQ, Dave Marling 29
VE6BGL, W.S. Gardiner 30
VHF/UHF contesting 79
VisiTel modification 36
voltage protector 40–41
W1XU, Jim Gray 92
W8ASF, Fred R. Sharp 36
W9NGP, Ed F. Rice 50
WA3AJR, Marc I. Leavey, M.D. 59
WA5ZIB, Andy MacAllister 91
W6YUY, Robert E. Bloom 18
WBØQCD 53
WB6DFQ, Ron Wong 35
WB6IGP, C.L. Houghton 12
WB8VGE, Mike Bryce 71
WB9RRT, Larry R. Antonuk 32
yagi 77, 79

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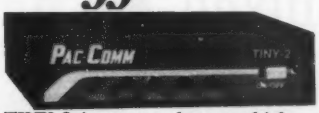

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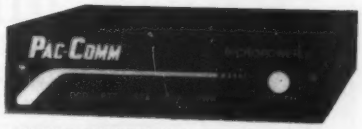

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73 ADVERTISERS INDEX

R.S.#		page
279	Ace Communications	42
355	Ace Communications	97
335	Ace Systems	16
1	Advanced Computer Control	84
65	Advanced Electronic Appli	95
67	Alinco Electronics	104
194	All Electronics Corp.	73
•	Allied Appliance & Radio	65
•	Amateur Electronics Supply	56
314	Ameritron	76
4	Amidon Associates	73
89	Antennas West	28
90	Antennas West	28
236	Antennas West	57
302	Antennas West	65
303	Antennas West	65
304	Antennas West	15
5	Antennas West	103
107	Antennas West	89
271	Antique Radio Classified	28
328	Applied Digital Research	62
•	ARRL	101
338	Ashton ITC	28
•	Associated Radio	74
16	Astron Corporation	49
357	ATFab	55
243	AXM Inc.	57
158	Azimuth Communications	81
137	B & B Instruments	16
53	Barker & Williamson	70
41	Barry Electronics Corp.	43
42	Bilal Company	103
176	Bird Electronics Corp.	101
156	Buckmaster Publishing	28
7	Buckmaster Publishing	65
365	Buckmaster Publishing	103
92	Burghardt Amateur Radio	31
•	Butternut Electronics	89
356	C & S Sales Inc.	62
•	CB City International	103
•	CES Inc.	83
157	Cleveland Inst. of Electronics	65
186	Coaxial Dynamics	81
343	Commpute Corp.	28
99	Communication Concepts	84
121	Communications Electronics	34
10	Communications Specialist	2
12	Connect Systems	1
334	Contact East	57
367	Cotronics Inc.	52
306	Creative Control Products	65
147	Data Com International	87
310	Davie Tech, Inc.	15
•	Dayton Hamvention	75
•	Delaware Amateur Supply	78
263	Dentron Radio Corp.	15
342	Digimax	15
239	Digital Radio Systems Inc.	103
112	E. H. Yost	57
291	Electron Processing	70
•	Electronic Equipment Bank	96
128	Electronics Book Club	67
•	Engineering Consultants	102
324	Epsilon Co.	55
75	Fair Radio Sales	65
339	GGTE	48
98	Gilfer Shortwave	23
17	GLB Electronics	70
72	Glen Martin Engineering	84
273	Gordon West Radio	27
346	Great Circle Maps	15
327	GTI Electronics	65
326	GTI Electronics	48
309	Hamtronics	103
•	Hamtronics, Inc.	25
•	Heath Co.	93
•	Heath Co.	92
308	Horizon Manufacturing	83
269	Hustler, Inc.	81
354	ICOM America	C2
•	Indiana Hamfest	102
358	Intercon Data Systems	55
97	International Radio	55
22	Jan Crystals	84
245	Jensen Tools & Alloys	55
•	Jo Gunn Enterprises	65
272	Jun's Electronics	101
94	K9RKA - ATV	55
•	Kenwood U.S.A. Corp.	C4
•	Kenwood U.S.A. Corp.	7
•	Kenwood U.S.A. Corp.	10
•	KW Litho	57
138	Lindsay Publications	55
25	Madison Electronic Supply	16
47	Maggiore Electronics Lab	47
336	Magnaphase	97
101	Maxcom Inc.	89
114	Metro Printing	57
24	MFJ Enterprises	3
162	Michigan Radio	88
348	Micro Computer Concepts	48
295	Micro Cont Specialities	74
252	Midland Technologies	48
187	Mission Communications & Consulting	48
163	Mobile Mark	70
127	Motron Electronics	103
323	National Tower Co.	27
349	Naval Electronics	52
•	Nemal Electronics	97
292	Omar Electronics	57
96	Orlando Hamcation	51
•	P.C. Electronics	89
•	P.C. Electronics	53
152	Pac-Comm	87
178	Pacific Cable Co. Inc	57
366	Packet Products	57
68	Periphex	28
66	Pipo Communications	30
30	QEP's	48
145	QSO Software	46
34	Ramsey Electronics	39
142	RF Enterprises	90
•	RF Microtech	97
•	RF Parts	37, 66
254	Ross Distributing	28
•	Sangean America	23
332	Satellite City	87
	73	
	Back Issues	73
	CB to Ten	68
	Code Tapes	68
	Dealer	52
	DX Map	68
	QSLs	68
	Subscription	17
	Uncle Wayne's Bookshelf	69
244	Software Systems	48
250	Software Systems	62
51	Spectrum Communications	26
183	Spectrum International	97
37	Star Tone Electronics	87
82	Stone Publishing	65
•	T.S. Skogen Etchings	62
•	TAB Books	61
•	Tandy Parts	33
•	The Ham Station	83
55	The Meadowlake Corp.	89
150	The Radio Works	48
115	The RF Connection	48
•	Tropical Hamboree	47
136	Unadilla/Antennas Etc.	52
79	Vanguard Labs	57
298	VHF Communications	57
38	W9INN Antennas	28
•	Wheaton Hamfest (WCRA)	73
319	Wi-Comm Electronics	62
191	WNW Associates	23
165	Yaesu Electronics Corp.	C3
351	Zeltwanger Electronics	28

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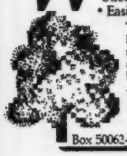

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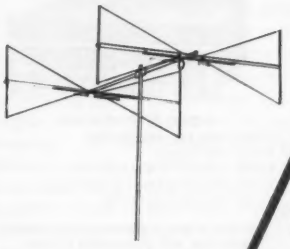

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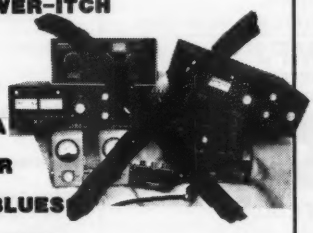

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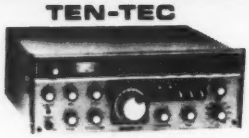

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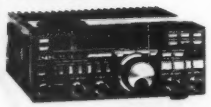

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Hamsats a Year Older

The dawn of a new year represents new beginnings. The new year brings the inevitable resolutions. Some good ones for the current or potential satellite operator include joining or renewing AMSAT membership, finishing antennas or radio projects, and getting more operating time on the satellites.

For example, AMSAT-OSCAR-7 was last heard in the summer of 1981. There have been no contacts via this satellite since then. Unless something remarkable happens, it is history. The shortwave bands won't disappear tomorrow, but we can only guess the life spans of RS-11, Fuji-OSCAR-12 or AMSAT-OSCAR-13.

Amateurs who are already active via satellite, and who have all the HF, VHF, UHF, and microwave equipment they need for satellite fun, might consider helping someone else get started with satellite chasing this year—explain it, or better yet, demonstrate a functional earth station.

Station descriptions can be pieced together by reading through all of the Hamsat columns during the last two years. New rigs, antennas, and accessories can out-perform the older equipment, but many of the systems that performed well for A-O-10, still do great for A-O-13, five years later. What is the average A-O-13 operator using today?

What It Takes

Many how-to's written on satellite operation tell you that you can make contacts with simple systems using inexpensive radios and home-brew antennas. They are right. Many AMSAT-OSCAR-10 enthusiasts proved that (with the right conditions) a few watts to a small manually-pointed yagi, or more power into a mobile magmount, provides good uplink signals; and that a dipole hung on the wall, followed by a small receive converter and an HF rig, can hear signals from space. It may not be a piece of cake at times, but it has been done many times.

Successful A-O-13 Activity

The following is not a description of a QRP (low power) satellite station or an indoor antenna system, but a brief guide for successful A-O-13 Mode B activity.

The easier a station is to use, the more it will be operated. Very rarely does a new satellite chaser put together all of the ingredients for the ultimate earth station at one time. It is a process of experimentation and learning.

So, how does one get a station ready for A-O-13? The most popular transponder on A-O-13 is Mode B. This requires an uplink signal from the operator, using CW or lower sideband from 435.423 to 435.573 MHz. This 70 cm up, and 2 meter downlink-type transponder worked successfuly on A-O-7. For A-O-13, most contacts are made on uplink frequencies close to 435.500 MHz. Downlink reception is from 145.975 to 145.825 MHz, CW, or upper sideband.

Note the frequency guide in last month's column. The Mode B transponder is inverting, thus a lower sideband transmission on 435.443 MHz will result in an upper sideband signal on 145.955 MHz, while an uplink on 435.553 MHz will come out on 145.845 MHz. CW activity is usually heard below 145.900 MHz, while sideband users stay above 145.900 MHz.

Since the VHF and UHF bands used by A-O-13 are primarily line-of-sight, satellite access is only possible when A-O-13 is above the operator's horizon. The best way to predict when A-O-13 will be available from a specific location is to use a good satellite tracking program on your computer. AMSAT offers software for many computers. Some programs provide simple tabular listings showing basic tracking information, while others can produce world maps with real-time, multi-satellite tracking. Regardless of the program's complexity, the point is to know when to operate and where to aim the antennas. If a computer is not available, there are mechanical aids for tracking, or a friend may be able to print predictions. Due to the elliptical shape of A-O-13's orbit, guessing the satellite's position won't work. Long-term commitment to satellite chasing requires access to a computer with tracking software.

Most active operators have multi-mode, 2 meter, and 70 cm transceivers. Commonly heard rigs include the Yaesu FT-726R or FT-736R, the ICOM IC-271 and IC-471 pair (A or H suffix), the IC-275 and IC-475 pair (A or H suffix), and the Kenwood TS-711A and TS-811A pair. For those with the H-suffix ICOM rigs (high power of 75 watts) no external amplifiers are used. Others with 25 watt radios usually buy an amplifier. The idea is not to overpower the satellite, but to have the extra output available when the satellite does not favor the user's location. An example is when A-O-13 is at apogee (highest point of the orbit) with its gain antennas pointed away. Amplifiers commonly used include Mirage, TE Systems, and RF Concepts. You can expect consistent and satisfying results with 50 to 100 watts.

Quality coaxial cable and good antennas up in the clear round out the complete earth station. For the cable, most use Belden 9913 coax with N-connectors for the slightly larger center conductor of the 9913. Keep the coax runs short. If the rig or antennas use SO-239 connectors, then use PL-259A connectors (Teflon dielectric) on the cable. Avoid jumpers and extra coax adapters.

Satellite antennas don't need to be high; they just need to be able to "see" the sky. It's best to have an unobstructed view of the horizon in all directions. Trees and buildings attenuate both received and transmitted signals. Commonly used antennas are circular-polarized, commercially-built crossed yagis. Manufacturers include Cushcraft, Telex/Hy-Gain, Mirage/KLM, Tonna, and others from Spectrum International. The first three brands are the easiest to find.

The AOP-1 package from Cushcraft includes a 20-element 2 meter crossed yagi, a 16-element 70 cm crossed yagi, and a mounting boom with a mounting plate for the Alliance U100 rotor (for elevation control). It does not come with polarization switching, and it does not use stainless steel hardware, but it is the least expensive. The cable harness typically is set for RHCP (right hand circular polarization) to conform with most satellites. You can buy the antennas, crossboom, and mounting plate separately, if necessary. A polarity switch is available for the 70 cm antenna and a 10-element 2 meter crossed yagi is an alternative for those with space constraints. The smaller antenna exhibits less gain.

The OSCAR Link antenna system from Telex/Hy-Gain offers advantages over the Cushcraft system, but averages about $100 more. It includes a 16-element 2 meter crossed yagi, a 30-element 70 cm crossed yagi, and a heavy-walled fiberglass crossboom. Hardware is stainless steel with ultra-violet stabilized plastic insulators. Many other items have been carefully engineered, including polarization switching relays rated at 200 watts. For a cost-effective system with excellent performance, this antenna array is the best choice.

The finest antennas are made by Mirage/KLM. Two versions of the 2 meter crossed yagi are available. One has 14 elements and the other has 22. Just the 2M-22C (22-element antenna) costs more than the complete Cushcraft package, but it includes a switch and stainless hardware. For 70 cm there is either an 18-element or 40-element antenna.

Most stations have preamps. For a few, signals from the satellites are sufficient without a preamp. These stations have state-of-the-art radios with GaAs-FET front ends and large antenna arrays. For those with long coax runs, preamps are placed at the antenna. This way, weak downlink signals are amplified before they are lost in the coax. With a short coax run, you can place the preamp near or in the radio. Advanced Receiver Research, Hamtronics, Landwehr (from Henry Radio), and Microwave Modules Ltd. (from Spectrum International) manufacture many of the commonly used preamps.

There are many ways to get a functional satellite station on the air. Other manufacturers of VHF and UHF rigs and antennas exist, and tracking software has been written and sold by companies and individuals other than AMSAT. Several transponder modes are available via A-O-13, but getting a fully functional Mode B station on the air is an important start.

For further information, consult *The ARRL Handbook, The ARRL Operating Manual, The Satellite Experimenter's Handbook,* the many AMSAT publications, and the AMSAT HF and satellite nets.

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PROPAGATION

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January 1989

January will provide some excellent DX on all bands from 160–10 meters. You may find, however, that the week between the 9th or 10th and the 16th or 17th will be spotty. In fact, days in these two periods may be poor with high magnetic index (A) values due to an unsettled-to-active geomagnetic field. Otherwise, static levels will be generally low during the month, and great DX should be available on the lower HF bands of 160, 80, and 40 meters.

Thirty meters will also be good, but, as the frequency increases, the HF high bands will close earlier. Ten will close just before dark on most days, and 15 meters will soon follow. Twenty will stay open quite nicely for an hour or two after local dark.

January is not generally considered a good DX month, but with sunspots increasing rapidly and solar flux values holding well above 150, the conditions will be better than they have ever been in a long time.

For those interested in astronomical events, Earth will be closest to the Sun on January 2, the Moon will be closest to Earth on the 11th, and a full Moon will occur on the 22nd. No eclipses are in the forecast for January. January is not exactly a "ho-hum" month, but it is generally far less exciting than March or September.

You may find some very good VHF openings in January, however, so keep your ears tuned. As always, listen to WWV at 18 minutes after each hour for up-to-date broadcasts of solar flux and geomagnetic (A) and (K) indexes. The higher the flux and the lower the (K) and (A) indexes, the better conditions will be for propagation on the HF bands.

The Source

Readers often ask me about the source of my predictions. I use the *Shortwave Propagation Handbook—Principles, Theory, Predictions* edited by George Jacobs W3ASK and Theodore J. Cohen N4XX. The edition I have was published in 1979 by the Cowan Publishing Corporation, 14 Vanderventer Avenue, Port Washington, NY. The book is priced quite reasonably at under $10.

The book assumes the reader is a neophyte to propagation matters and gives a good understanding of the mechanisms of long-distance transmission and reception of radio signals.

If you read this book thoroughly, you'll be able to make your own forecasts with reasonable accuracy for any time of the year, for any year in any sunspot cycle. 73

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	20	–	–	–	–	20	20	–	–	–	15
ARGENTINA	20	40	40	40	–	–	20	15	15	10	10	15
AUSTRALIA	15	20	20	–	40	40	40	–	–	20	20	15
CANAL ZONE	20	20	20	20	20	20	20	15	10	10	15	15
ENGLAND	40	40	40*	40*	–	20	15	10	15	20	20	–
HAWAII	15	20	–	–	–	–	20	20	20	10	10	15
INDIA	–	–	–	–	–	–	20	20	–	–	–	–
JAPAN	15	20	–	–	–	–	20	20	–	–	–	15
MEXICO	20	20	20	20	20	20	20	15	10	10	15	15
PHILIPPINES	–	–	–	–	–	–	20	20	–	–	–	–
PUERTO RICO	20	20	20	20	20	20	20	15	10	10	15	15
SOUTH AFRICA	20	40*	–	–	–	–	20	10	10	10	15	20
U. S. S. R.	–	–	–	–	–	–	20	15	20	20	–	–
WEST COAST	15/20	20/40	80	160	160	160	–	–	–	10	10	15

CENTRAL UNITED STATES TO:

ALASKA	15	–	–	–	–	–	–	20	–	–	–	15
ARGENTINA	20	20	20	40	40	–	20	20	15	10	15	15
AUSTRALIA	15	20	20	–	–	–	40	–	–	–	15	10
CANAL ZONE	15	20	40	40*	40*	–	20	15	10	10	10	15
ENGLAND	40	40	80	–	–	–	–	20	15	15	20	40
HAWAII	15	20	–	40	40	40*	40*	20	20	15	10	15
INDIA	–	–	–	–	–	–	–	20	–	–	–	–
JAPAN	15	–	–	–	–	–	–	20	–	–	–	15
MEXICO	15	20	40	40*	40*	–	20	15	10	10	10	15
PHILIPPINES	15	20	–	–	–	–	–	20	–	–	–	15
PUERTO RICO	15	20	40	40*	40*	–	20	15	10	10	10	15
SOUTH AFRICA	20	40	–	–	–	–	–	15	10	10	15	20
U. S. S. R.	–	–	–	–	–	–	–	20	15	20	–	–

WESTERN UNITED STATES TO:

ALASKA	10	15	20	–	–	–	40	40	40	–	–	20
ARGENTINA	15	20	–	40	40	–	–	20	–	10	10	15
AUSTRALIA	10	15	20	20	–	–	40*	40*	20	20	15	15
CANAL ZONE	15	20	20	–	–	–	–	20	15	10	10	10
ENGLAND	20	40	40	–	–	–	–	–	15	15	20	20
HAWAII	10	15	20	40	40	40	–	20	20	15	15	10
INDIA	–	15	20	–	–	–	–	–	20	–	–	–
JAPAN	10	15	20	–	–	–	40	40	40	–	–	20
MEXICO	15	20	20	–	–	–	–	20	15	10	10	10
PHILIPPINES	10	15/20	15/20	–	–	40	40	40	–	20	–	20
PUERTO RICO	15	20	20	–	–	–	40	40	40	–	–	20
SOUTH AFRICA	20	20	–	–	–	–	–	–	15	10	15	15
U. S. S. R.	–	–	–	–	–	–	–	–	20	20	–	–
EAST COAST	15/20	20/40	80	160	160	160	–	–	–	10	10	15

JANUARY

SUN	MON	TUE	WED	THU	FRI	SAT
1 G	2 G	3 G	4 G	5 F	6 G	7 G
8 G	9 G–F	10 F	11 F–P	12 P	13 P	14 P
15 P	16 P	17 P–F	18 F	19 F–G	20 G	21 G
22 G	23 G	24 G	25 F	26 F–G	27 G	28 G
29 G	30 G	31 G				

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Bandwidth!

The other day, I was having a nice conversation on 20 meters with a guy who was running S-7 to S-8. Suddenly, another station came on 1 kHz below us, running about 10 over 9, and wiped us out. I went down to his frequency and politely requested that he move, as we were only 1 kHz up. His response: "I'm a kilohertz below you, I shouldn't be bothering you!"

For a moment, I didn't know what to say. Understanding the concept of bandwidth is one of the most basic requirements of station operation (not to mention licensing), yet here was a ham who clearly didn't know (or didn't recall) what it was!

While most hams are familiar with the concept, judging from the QRM on the bands, at least some hams have a less-than-clear mental picture of what goes on spectrally when we speak into our mikes. This month's column seeks to clarify this.

The 3 kHz Range

In a properly operating SSB rig, the transmitted bandwidth is equal to the modulating frequencies. For us, that's 3 kHz maximum, as required by law on the amateur HF bands.

Look at Figure 1. It represents a portion of the 20 meter band. The section over which the curve sits represents your USB signal on 14.300 MHz. Now look at the measure below the curve below the graph. Depending on your sex, voice qualities, what you are saying, and especially the type of microphone you use, the distribution of the transmitted energy may favor the low voice frequencies, high voice frequencies, or somewhere in between. The areas bounded by the curves in the two figures, for example, shows a concentration of voice frequencies in the middle ranges.

For all practical purposes, you are using up your entire 3 kHz allotment at any time. So you're not really on 14.300; you're on 14.300 to 14.303! 14.300 is merely where your carrier WOULD be if you were operating AM and, of course, what your dial or digital read-out shows. It is clear, then, that stations can be 3 kHz apart without interference. (In practice, a bit more room is required because receiver filters are not perfect.)

"Monkey Chatter" and Rumblings

Now, look at Figure 2. If a station has moved only 1 kHz below you, the bandwidths will overlap, and his or her upper voice frequencies will appear where your receiver will interpret them as LOWER frequencies. You will hear unintelligible rumblings. On the other hand, if a station is, say, 2 kHz ABOVE you, you will hear squeaky "monkey chatter" because his lower voice frequencies will appear where your receiver will interpret them as UPPER frequencies.

On LSB, everything's reversed. Your bandwidth extends for 3 kHz BELOW your dial frequency. On the diagrams, the lows and highs will be reversed. Monkey chatter comes from stations below you and rumblings come from above.

Nearly all of today's rigs have a control which allows you to narrow the bandwidth of your receiver and filter out some of the QRM. (A notable exception is the new Yaesu FT-747. Shame!) The technique is pretty effective, especially on the monkey- chatter type of QRM, but the price you pay is that the signal you want to hear is also degraded. Cutting the monkey chatter muffles reception, and reducing the rumbling makes the voice tinny. But, at present, there is just no other way.

"Nearly all of today's rigs have a control which allows you to narrow the bandwidth of your receiver and filter out some of the QRM."

Notch Filters

By the way, reduction of this type of interference is not the purpose of a notch filter. These filters put a narrow, deep null in your passband and are intended only to remove heterodynes ("tuner-uppers"). The null isn't wide enough to remove the wide band of frequencies present in a voice signal.

Finally, don't forget to keep your bandwidth in mind when deciding how close to the band edge to set your dial, or some of your signal could wind up outside the band. A friend of mine forgot this and got a pink warning slip from you know who!

Now that we've vanquished QRM from the bands (hah!), let's look at this month's letters.

Dear Kaboom,

I have a problem. I bought a car with fuel injection, and have I got a noise in my mobile HF rig! It sounds like the ignition, but only on 20 meters. I've never had trouble like this in my other cars. I'm disgusted with this computer junk. What can I do to clean up the noise?

Signed,
Annoised

Dear Annoised,

Obviously, something in that car has a harmonic on 20 meters! Generally, computer-generated noise sounds very different from ignition noise, so I doubt that the car's central processor is the culprit. Especially if the noise is very broadband (covering the entire band), I would say it is not caused by a computer.

Does the car have digital instrumentation? Those big fluorescent read-out tubes seem like logical noise suspects to me, but again, the noise should sound very different from ignition.

The most likely cause is from pulses delivered to the fuel injectors, or by good old ignition. As always, shielding wires may help. Also, check to see if the noise is present only when the car moves. Hash could be coming from wheel bearings, tires, the transmission, or any other moving mechanical system.

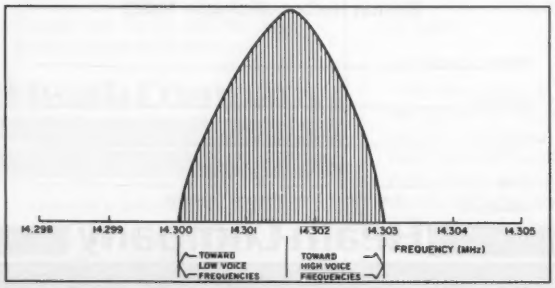


Figure 1. A diagram of a USB signal when the rig is tuned to 14.300 MHz transmit.

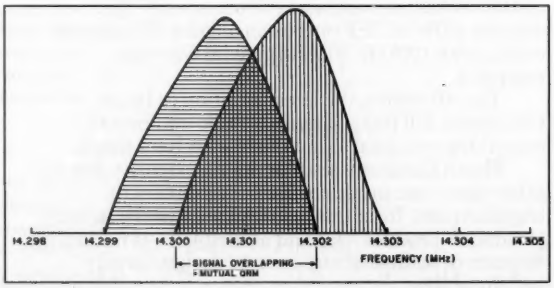
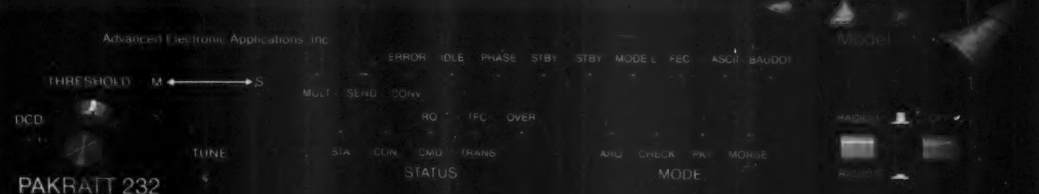


Figure 2. Two USB signals, tuned to 14.299 MHz, and 14.300 MHz respectively. Note their overlap, which extends from 14.300 to 14.302 MHz. When signal bandwidths overlap, you will hear, on the frequency in question, rumblings on its lower frequencies and monkey chatter on its higher frequencies.

Others May Try to Imitate, But...

Only One Can Be The Best



Morse Code - Baudot - ASCII - AMTOR - Packet - Facsimile - Navtex

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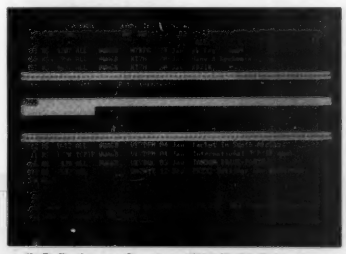
It's a lesson you learn very early in life. Many can be good, some may be better, but only one can be the best. The PK-232 is the best multi-mode data controller you can buy.

1 Versatility

The PK-232 should be listed in the amateur radio dictionary under the word Versatile. One data controller that can transmit and receive in six digital modes, and can be used with almost every computer or data terminal. You can even monitor Navtex, the new marine weather and navigational system. Don't forget two radio ports for both VHF and HF, and a no compromise VHF/HF/CW internal modem with an eight pole bandpass filter followed by a limiter discriminator with automatic threshold control.

The internal decoding program (SIAM[tm]) feature can even identify different types of signals for you, including some simple types of RTTY encryption. The only software your computer needs is a terminal program.



PC Pakratt Packet TX/RX Display

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2 Software Support

While you can use most modem or communications programs with the PK-232, AEA has two very special packages available exclusively for the PK-232....PC Pakratt with Fax for IBM PC and compatible computers, and Com Pakratt with Fax for the Commodore 64 and 128.

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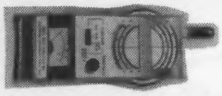

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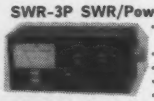

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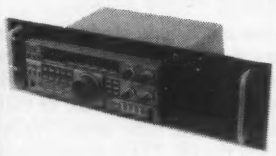

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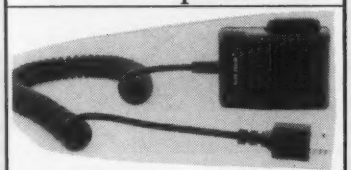

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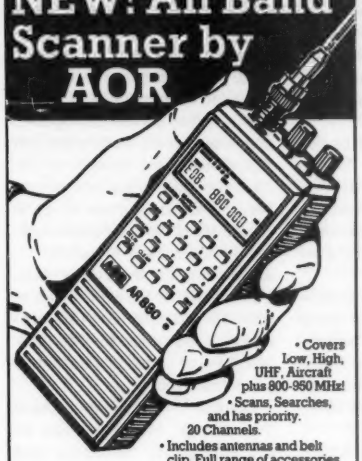

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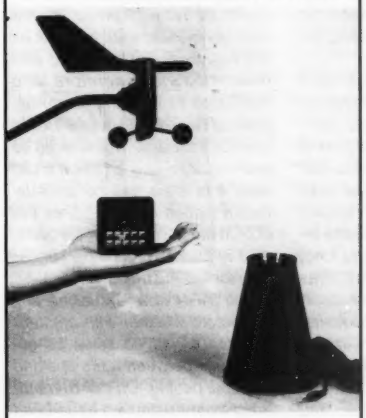

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73 INTERNATIONAL

edited by C.C.C.

Notes from FN42

Korea and the Olympics. *Sometimes things just plain go wrong—and our planned coverage of the Olympics just plain went wrong. Byong-Joo Cho HL5AP did his part, but a combination of postal services and office confusion led to our failure to get two of his reports and to temporarily (from February 18 to September!) mislay another one. HL5AP earned his subscription to 73 and he'll get it; for those of you who may have been looking for our coverage—apologies. CCC hopes you got the information you needed elsewhere.*

As usual we have much more material than can fit in these pages, but the IARN information from Sam Voron VK2BVS, Peter ZS6ET's first Hambassador report from the Republic of South Africa, and Hambassador UA9MA's material clearly deserved priority attention. (Even so, two-thirds of the report from ZS6ET will have to be held over for the future.)

Anyway, HAPPY NEW YEAR to those who are starting 1989 on the 1st of January (with the 2nd being Dia del Ano Nuevo, Nouvel An, Neujahrstag, and New Year's Holiday in Scotland), and a plain old wish for happiness to those whose new years begin later; we'll celebrate the dates of theirs at the appropriate times. Other January dates to note for your QSOs: January 1 is Haiti's Independence Day (on the 4th for Burma and the 31st for Nauru); 7—Ethiopian Christmas; 9—Martyrs' Day, Panama (the 29th for Nepal); 15—Adults' Day, Japan; 23—National Holiday, Australia; 24—Economic Liberation Day, Togo; 26—Anniversary of the Proclamation of the Republic, India.

Roundup

Australia. (And Jamaica, USA, El Salvador, Mexico, New Zealand, Great Britain, Germany, Belgium, Sweden, Israel, Cayman Islands, United Kingdom, Japan...other countries).

HURRICANE GILBERT

Emergency.....!

The following is from a report by the IARN Director for Australia, Sam Voron VK2BVS (4071066), 2 Griffith Avenue, East Roseville 2069, Australia. Chris CK3YID in Melbourne, 036014222, has just attempted to telephone Glenn Baxter K1MAN (Network Manager of the International Amateur Radio Network (IARN) in the USA... he is told K1MAN busy handling emergency traffic...something about a hurricane in the ocean off the eastern US coast...halfway around the world...

Nothing to concern me, weather lovely in Sydney. But let's tune in on NBC's "Today" show, which is aired every night over a VHF Sydney commercial TV channel...

Jamaica hit by biggest hurricane ever recorded in the northern hemisphere, 500 miles wide...

Mexico City and San Salvador were halfway around the world, too, and they sure needed all the help Australian hams could give...

The Australian Traffic Network is activated...VK3CKK 037291624 notified Red Cross ...VK6OP 092774661 and VK6RQ 092771514, Perth, to handle Red Cross-referred calls on health & welfare matters... 14.275 MHz declared emergency frequency (with ±5 kHz guard band), to be controlled by IARN to carry messages from the Jamaican Defense Force station 6Y5B64...many on this frequency because all power, phones, navigational aids at airfields out: aircraft, US State Department, Salvation Army, Red Cross... only well-prepared hams, with generators and fuel, able to provide vital remaining links... 14.325 MHz (±3 kHz), other FCC channel for emergencies, controlled by National Hurricane Center in Miami...hurricane planes use this as they fly through the storm to measure and track it...

Australia and New Zealand relay important info when conditions make coverage difficult...we watch the Caribbean and jump in when needed...over 100 health & welfare messages generated now, relayed to Jamaica through the US since no third-party agreement with Jamaica—so direct service without delays involved when third-party agreements get negotiated before help can be provided...

New Zealand authorities meanwhile ruled that NZ radio amateurs could not help the public despite no telephone communication existed...G4SCA on British RAYNET (the RSGB emergency group) activated and helping the British High Commission... DA2GY in Germany active as well as full US Army Military Affiliate Radio System (MARS)... Belgium, Sweden also; all providing health & welfare message help...Israel amateurs stay alert....

Weekend of 17 September coming up; would everything settle down so we can go ahead with our annual 48-hour Amateur Radio Display at El Park, which was supposed to coincide with our simulated emergency test?...

Cayman Islands hit...storm headed for Mexico...annual Australian Fun in the Sun and Under the Moon amateur radio display and simulated emergency test cancelled...five US amateurs deployed to set up facilities in Jamaica—Dave K2BPP, Ralph N4HTU at Montego Bay with access to commercial telephone satellite link...Bill WB2TUU with Oral Roberts medical team near Kingston...Bob N4MHV at Sandy Bay...Al W9ELR at Kingston Salvation Army station....

September 19: Australian Traffic Net sends ***Happy Birthday*** *to IARN: it's three years since the Mexico City earthquake and the birth of IARN...*

Relief agencies not able to send in medical volunteers without assurance of radio amateurs available full time and US volunteers in Jamaica have to leave (a wife having a baby, etc.) and new ones getting hard to find...United Kingdom offers two, Australia requested by IARN to send one, Japan asked for volunteers...as of September 20...no transport available for non-US volunteers, but Gordon VE3FBU an exception—accompanied Jamaican Consular General, set up communications at Runaway Bay, and this message broadcast:

Situation in Jamaica now urgent. Need food, building material, antibiotics of all kinds, clothing. We have no beds and water is very bad. The people of Jamaica are making all efforts to ensure all tourists are being taken care of.

Australia active 0500 to 1000 hours universal time when, although many net control stations monitoring 14.275, North America mostly asleep and/or coverage into Jamaica difficult...so manning net control...assisting traffic from Europe to Jamaica and Jamaica to US, so Jamaica stations can come on frequency anytime, get messages off, and go off the air to conserve fuel or batteries...Ashley 6Y5GR can operate only Morse code, battery low, but reports excellent, relayed to US: all water has to be boiled, bananas and sugar cane all gone ...VE3FBU reports people sucking on sugar cane to survive... above message causes Australian Dept. of Foreign Affairs to donate $20,000 to help Jamaica...US asked for $400 million: 95% of Jamaica's economic base destroyed...

October 1, 1988 summary (as of this writing). 14.275 remains as the emergency frequency and IARN continues to look for volunteers to go to Jamaica to man field stations. More Jamaica stations coming on the air as the president of the Jamaica Amateur Radio Association (JARA), Selvin 6Y5SG, mobilizes resources. Dave K2BPP draws up disaster communication plan, is debriefed by US representative assessing Jamaica's needs. IARN has donated quantities of gear—aerials, generators, you name it—personally owned as well as from AEA, Heath, Tandy, others.

I am proud of the way so many newcomers to amateur radio became so fully involved in this emergency, and want to thank all US Novices, Technicians, and other 10-meter operators who monitored 14 MHz and kept Australia fully informed when 14 not open to Australia. This worked so well that from now on when a disaster hits there will be an Australian station looking...into the USA in the US Novice voice band, 28.3 to 28.5 MHz as a part of our plan for the Australian net.

The IARN now is seeking any volunteers whether with amateur licenses or not, to serve as go-betweens between radio ops and the local people. On the 10-meter band from Australia, I have been asking USA Novices and Technicians to contact the public via local radio stations, talk shows, CB airwaves, SWLs, scanner listeners, to tell that volunteers are needed to be the eyes and ears of Jamaica.

Volunteers can always phone Glenn Baxter K1MAN (207) 495-2215. or FAX (207) 495-2069. [Ed. note: As of January the foregoing may be out of date, but the need for IARN volunteers to be available never is.—CCC]

Japan. From *The JARL News* for August: "It is essential that all hams be aware of the current worldwide trends that affect amateur activities. Amateur radio communications means worldwide communication and thus worldwide interaction." Living up to this, JARL sent a delegation to the Region III annual meeting in Seoul, South Korea (in October), which included the president, vice president, and managing director (JA1AN, JA6AV, and JA1HQG). "Japan has the most amateurs in the world and is expected by other countries to play a leadership role in Region III and shoulder responsibility for the development of international amateur radio."

GREAT BRITAIN

Jeff Maynard G4EJA
32 Waldorf Heights
Hawley Hill
Camberley GU17 9JQ
England

The UK Scene The major news is the publication of the new UK amateur license by the UK regulators, the Department of Trade and Industry. It incorporates a number of significant changes, all of which are for the better. Although largely cosmetic or administrative, they have relieved the amateur of a number of bureaucratic chores and should, if nothing else, ease the conscience of those who did not fully stick to the rules.

Until now a multipage document, the license is in two parts. A single-sheet validation document confers legality and is renewed annually (when the fee is paid!), and a separate booklet sets out the terms and conditions of the license. The same documents serve all types of amateur stations—club, reciprocal, maritime mobile (but not aeronautical mobile, despite the efforts of the RSGB).

The Europeanization of the UK continues apace with the adoption in the new license of the standard CEPT draft agreement, allowing visiting CEPT license holders to operate in the UK and UK amateurs to operate in most European countries without special permission. (CEPT is the European PTT 'club' which sets many international telecommunications standards.) US amateurs can still, of course, apply for a reciprocal license.

Other changes:

- The rather strange UK suffix /A (for operation from a so-called 'alternate' address) has been replaced with /P for operation away from the main station, and may be used for unlimited periods instead of for only four weeks at a time.
- The DTI has recognized the arrival of the computer age and now permits the station log to be kept on magnetic tape or disk and has relaxed rules defining what must be recorded.
- Computer buffs can now legally operate their 'digipeaters' and can receive and transmit digital messages without the (theoretical) need to review each one.
- Low power beacons may now be set up without special permission, and low power links are OK for remote control.
- When operating other than with telephony, it is no longer necessary to ID with a CW transmission of at least 15 wpm—it can be sent in Morse at any speed. When retransmitting a recorded transmission from another station, it no longer is required that the recorded callsigns be deleted before retransmission.
- Restrictions have been removed for operating an amateur station on behalf of social organizations—such stations are no longer required to notify the DTI of their names. (Helpful. I remember the problems of trying to organize GT4EJA/MM for charitable purposes a few years ago.)
- And it is now permissible to conduct crossband contacts using receive frequencies not licensed in the UK (but presumably legal in the country of origin).

The very observant of you might have noticed all-American spelling this time (license not licence, organization not organisation). This is due to my use of the US version of a word processor (Professional Write); I now have an IBM PS/2 operating under PC-DOS. Good news in that the IBM is much faster than my old Apple 2 and much more versatile and I have access to a wide range of software. Any helpful contributions from you would be most welcome because the bad news is that all my amateur software (SSTV, RTTY, CW send and receive, satellite orbital predictions) is no more, and I don't know what is available. While home computers are popular in the UK, things tend to be home-grown nonstandard such as the BBC. There is, therefore, a complete lack of amateur software for industry standard machines. What PC-DOS program disks do you have?

HONG KONG

Phil Weaver VS6CT
PO Box 12727
Hong Kong

They say lightning never strikes twice; I sincerely hope that this is true as once again HARTS suffered a major loss of equipment when the digipeater operating very successfully on 29.010 MHz was zapped by lightning in early August, leaving the antenna looking like a sad tail after the night before and the equipment full of little holes! I had never seen the likes of it. We still have not resumed that service [*written in mid-September—Ed.*] but I am hoping that the two beacons which have been established for a few years will be back up on the air shortly, after having been down for reconstruction of the building they are in. To remind those interested, the 10-meter beacon will be operating on 28.290 MHz and on 6 meters at 50.075, with the callsigns VS6TEN and VS6SIX respectively.

After my departure from HARTS (see column in the June, 1988, issue) I established a new society aimed at providing service for the expatriate community in the form initially of the provision of an English-speaking repeater. This is up and running on 145.575–600 with a CTCSS tone needed on the transmissions. If you are coming to Hong Kong and would like to learn more, drop me a line *at the above address* or phone me on arrival at 5–772313. The group is the English Language Amateur Radio Communications Society (ELARCS), and we have quarterly meetings at which all are welcome.

The PO address above is because I expect to move into a new apartment the first quarter of 1989 and don't yet have the new address. The saga of the flat move is an ongoing pain in the neck—should have moved a long time ago but a fire in the high rise, put out with helicopters using salt water from our 'fragrant' harbor, meant that the top two floors had to be demolished and reconstructed!

SOUTH AFRICA

Peter Strauss ZS6ET
PO Box 35461
Northcliff, ZA–2115
Republic of South Africa

Guest licenses in South Africa. South Africa decided in 1980 no longer to follow the example of the British and US administrations, as they issue licenses to bona fide tourists only if a bilateral agreement has been concluded between the home country of the tourist and the administration of the country to be visited. In South Africa this was considered discriminatory against tourists from rare DX countries whose administrations would not be willing to conclude an agreement for maybe one tourist in five years.

After extensive research by a select committee of SARL (the South African Radio League) into license procedures of other coun-

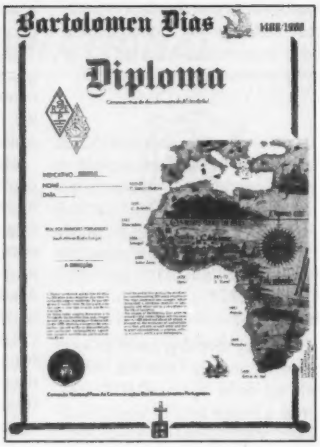
Lion Bob ZS1ABO, coordinator of joint amateur and Lion activities in South Africa. (Photo by Bob Adshade)

tries, a proposal was submitted to the authorities with the result that since 1981 any amateur from any country may apply for a 3 month permit to operate while in the Republic of South Africa. A fee of Rand 12 (approximately US$5) is payable on arrival. Two license classes compatible with the CEPT class I and CEPT class II are available. (No compatible license class to the US Novice license exists in South Africa.)

In order to cater for amateurs entering for longer periods and to allow for the permanent conversion of foreign licenses to South African callsigns, agreements with Israel, Portugal, the German Federal Republic, Chile and the USA followed. Agreements with Great Britain, Swaziland, Zimbabwe, Botswana, Bophuthatswana, Venda, Transkei, South West Africa and Ciskei have been in force for some time. Amateurs from agreement countries are not limited to a three-month permit. Their permits are issued free of charge and they may apply for the conversion of their home callsign to a South African callsign if they intend to stay permanently or semi-permanently in South Africa.

Any person, regardless of nationality, may sit for the multiple choice RAE exam in South Africa. In fact the Wits Central Repeater covering the greater Johannesburg area is typical for the cosmopolitan nature of amateur radio in South Africa. While QSOs are predominantly in English and Afrikaans, callers in German, Portuguese and Hebrew are very likely to get an instant answer even late at night.

Portuguese nationals living in South Africa may sit for the RAE in South Africa in their own language and obtain a certificate by their own administration in Portugal. Such license may by used to apply for a callsign in South Africa, easing the language problem for the many Portuguese speakers.



The IARU Region I band plan applies in South Africa and visitors should use the two-meter band from 144,000 MHz to 145,999 MHz only. The 220-MHz band is not available for the amateur radio service in South Africa.

Further information may be obtained by writing to the SARL at PO Box 3911, Cape Town 8000, Republic of South Africa.

Lions in South Africa. The days of the lions roaming free in the country are a thing of the past, with mining, agriculture, and urbanization claiming their share. Today's Lions can be found regularly teaming up with radio amateurs for events like the "Hunting Lions in the Air," held every January. This year's will be on January 7th and 14th.

This event seems to be very popular in South Africa, looking at the results of the 1988 event. First place in the Club category (phone) went to ZS6TJ. This station is located in the Johannesburg Amateur Radio Center (Louis Botha Ave., corner Duff Rd. Houghton, Johannesburg). Second place went to ZS6TVL located right next to the world famous Kruger National Park where one can still find real lions!

In the Club category (CW) the first place went also to ZS6TJ in Johannesburg. In Cape Town the third place was retained by ZS1VP in the individual operator CW category. Overall participation was also very high with South Africa fielding the second largest number of stations in the world, with only the USA fielding more stations. Considering there are only just over 5000 radio amateurs licensed in the Republic, this is no mean feat.

With many rare club and event stations scheduled to participate in this event again, this could be your opportunity to get a rare QSL card.

The Dias Award. The Bartolomeu Dias Award is a unique award issued to commemorate 500 years of some of the most important sea voyages which demanded a complete revision of geography and led to a new phase in the life of humanity.

The voyage of Bartolomeu Dias when he arrived in the Indian Ocean with his caravels in 1488 stands out above all others. It allowed for the encounter of civilizations until then unknown to each other and led to great consequences in science, culture, economics, politics, and demography.

Issued in cooperation between the Johannesburg Branch of SARL and the National Amateur Radio Society Portugal (REP), the award is a further step to increase the good relations of South African and Portuguese radio amateurs and their friends in the world.

To qualify, 5 contacts with South African (ZS/ZR) stations and 5 contacts with stations in Portugal (CT) in the period January 1, 1988 to June 1989 are required by stations other than those two countries. Applications must be submitted not later then December 31, 1990. All bands; CW, RTTY, and phone. Also available to SWLs. QSLs not required. Applicants should submit certified logs with 10 IRCs or US$5 to the Awards Manager SARL Johannesburg, PO Box 2327, Johannesburg 2000, Republic of South Africa.

[Packet radio report in a future issue.—CCC]

SOUTH AFRICA FIRST COUNTRY TO ACCEPT 73 UNIVERSAL APPLICATION

Peter ZS6ET writes: "If you intend to visit South Africa, address your application for an amateur radio permit to **The Department of Telecommunications, Private Bag X74, Pretoria 0001, Republic of South Africa.** The Universal Permit Application published in '73 International' [*see October's issue, page 88*] offers more information than required and should suffice." Peter's statement is based on information from the Department, but this is not an official approval, of course; that will not be sought until the form is further revised, based on comments and criticisms from around the world over the next two or three months.

WEST SIBERIA DX CLUB BEGINS SWDXC AWARDS PROGRAM

Gennady Kolmakov UA9MA, our Russian Hambassador, writes that "We have founded one of the first DX clubs in the USSR. . . with UA9MC as president . . . and UA9MD, secretary." UA9MA is vice president, and he sends us the following.

1. AOA (Arctic Ocean Award)— Details next month. **2. WAWS (Worked All West Siberia)**—Work following oblasts: 099, 100, 130, 145, 146, 158, 161, 162, 163. Class 1—40 QSOs in 9 oblasts, Class 2—30 and 8, Class 3—20 and 7.

3. U-PX-A (USSR Prefix Award)—Class 1—200 prefixes, Class 2—150, Class 3—100, Class 4—50.

4. U-1,000,000-C (USSR million-population Cities)— Work: Alma-Atu, Baku, Cheliabinsk, Dniepropetrovsk, Donetsk, Gorky, Kharkov, Minsk, Moscow, Novosibirsk. **5. PX-9-A (Prefix 9 Award)**—Work stations with figure 9 in their prefixes. Class 1—50 prefixes from 20 countries on 6 continents, Class 2—40 from 15 on 4, Class 3—30 from 10 on 3.

6. WSA (West Siberia Award)—Work stations from Zone 17 (WAZ) with the last callsign letters from which spell the title of the award. For example: UA9AW, UL7CE, UA9MS, UH8BT, and so on for all 16 letters.

All contacts (or SWLs) must be made after January 1, 1980. No QSLs; send certified list to **Serge F. Kruglov UA9MC, PO Box 836, 644099 Omsk, USSR.**

"Rules for WSDXC membership: 1) 100 awards and certificates, including 'R-150-S' (or DXCC with 150 countries) and 3 ones from WSDXC, or; 2) 200 countries (R-150-S or DXCC with 200 countries) and 3 awards from the WSDXC. The entering fee is 20 IRCs. All applications must be signatured by 2 licensed amateurs."

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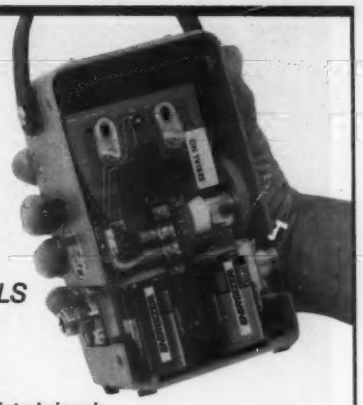

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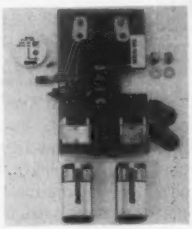

The 4300-400 kit pc board mounts inside the Model 43 housing, on the meter studs. Estimated conversion time is only 15 minutes from start to finish.

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And, the Model 4300-400 is surprisingly inexpensive. Contact your Bird distributor or factory for details.

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Photo B. Reinstalling the "phoenix" 2304 array. It worked well enough to bag five grids.

FN55, 64, 74, and even FN48, a grid located in a very remote section of Quebec, far north of Quebec City. The 2 meter station worked most of these same grids and bagged a fairly rare one in EM77 in central Kentucky. Our new operators couldn't have had a better introduction to the wacky world of VHF contesting!

After The Battle...

After the dust cleared, we wound up with about 550 QSOs and more than 165 grid squares, 51 of which were on 2 meters alone. And I've heard about even higher 2 meter totals from the Midwest, pushing well over 80. The best part was being able to knock all the stations down and leave for home just thirty minutes after the contest ended. Now that our new operators have survived basic training, maybe we'll give it a go again this January.

Mid-Atlantic Conference

The Mt. Airy VHF Radio Club, better known as the Pack Rats, just wrapped up another successful doubleheader weekend with the 12th Mid-Atlantic VHF Conference and Hamfest. They offered a good dose of technical presentations, an expansive flea market, and lots of fun. This was the first year I attended the banquet, and I managed to make a few of the seminars, which covered a variety of topics. Among them were: Propagation Enhancement Indicators, 6 meter Contest Arrays, VHF/UHF QRP Contesting, Water Cooling UHF Power Amplifiers, and Home-brew Microwave Dish Feeds.

About 100 people attended the banquet, and some great door prizes were awarded. Coaxial Dynamics graciously donated a wattmeter that I reviewed for *73*, and Avantek Corporation came up with several MMICs, bipolar, and GaAsFET devices, along with application sheets and PC boards. The evening concluded with a showing of the SCORE 1987 FM27 multi-projector show, after which all hands were off to the hospitality suite to talk shop while watching the Olympics.

Sunday brought overcast skies, that eventually cleared for a perfect sunny day. I brought some items to the flea market, many of which sold very quickly. There was more of a buying frenzy this year than last year (probably because it rained in 1987), and there were many good deals on antennas, coax, amplifiers, preamps, and just about any parts you can think of. If you live within a few hundred miles of Bucks County, try to make it in 1989. There's plenty of motel space for overnight stays, and it's fun to meet many of the faces that go with the familiar callsigns.

Project Time

From time to time, I will mention sources for microwave parts in this column. One of those sources is Steve Kostro N2CEI, who was selling at the Pack Rats flea market, and who has a nifty line of "roll your own" preamplifiers for 50 through 2304 MHz. I had already picked up a 903 MHz version and added a 1296 kit for good measure, with the idea of putting up mast-mounted preamps. Since I already had a pair of Dow-Key 260 relays in the parts box, it seemed like the thing to do.

The preamps sell for just $35 and include a Bud minibox, etched PC board, and all parts, including a NEC 720 series GaAsFET (typically a 72089 device). Steve claims a noise figure of better than 1 dB for these kits when properly tuned, and they are small enough to tuck away just about anywhere. They look like good weekend projects, and I'll let you know next month how they work.

Nice Tip

Incidentally, just how do you set up a preamp for lowest noise figure without a Noise Figure Meter? Well, it's easy if you have a weak signal source (such as a beacon), and you can switch to FM mode on your transverter/receiver combination or multimode. Then you just tune for best quieting. I tried this with a 432 and 220 preamp, and it works quite well, as the trimmer setting is not quite at maximum gain. Conversely, adjusting for maximum gain did degrade the signal-to-noise ratio somewhat. Thanks to W1VD for this tip.

Maximum quieting can be measured with a standard VTVM or FETVOM, using the AC scale and taking a signal from the quad detector or ratio detector. You can even take it from the speaker output, if necessary. It's not hi-tech, but it's a lot cheaper than purchasing an NF meter.

Once that preamp is set right, you'll want to put it in a weatherproof enclosure, add a few relays, build a sequencer, and run extra coax up the tower—it's all part of going Above and Beyond!

". . . we wound up with about 550 QSOs and more than 165 grid squares, 51 of which were on 2 meters alone."

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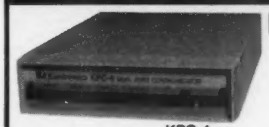

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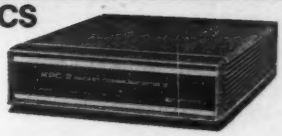

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- Includes VHF and HF modem — software selectable.
- Full duplex capability.

Price 149.00

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CIRCLE 309 ON READER SERVICE CARD

MEGA WATTS.

Alinco's new DJ-500T hand held dual bander really puts out.

Like 6.5 watts with the optional 12 volt battery. Or our standard 3.5 watts VHF and 3 watts UHF with a local power setting of .5 watts. No other HT delivers such power.

The DJ-500T also comes with mega features.

It's the only HT with a 37 tone encoder/decoder as standard equipment. You get cross band/full duplex operation. Twenty memory channels (10 apiece on VHF and UHF). Programmable offsets. A single memory 16 digit auto dialer and modifiable CAP/MARS capabilities*.

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Alinco's new DJ-500T hand held dual bander. Mega power. Mega performance.

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*Permit required.

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CIRCLE 67 ON READER SERVICE CARD

A high-performance HF rig... with a great receiver and full-power transmitter. Light in weight and low in price.

This is Yaesu's FT-747GX.

Whether you're a novice or a veteran, it's a great way to start. And a great way to go.

DX ready. The 747 packs a full 100-watt RF punch on 160 to 10 meters, with continuous receive from 100 kHz to 30 MHz.

And its control panel is refreshingly simple. So you can hop around the band *fast* to nail those DX stations. While other guys are warming up their amplifiers, you can be working the DX!

Multimode versatility. The FT-747GX is ready to go on LSB, USB, CW, and AM. With provision for the FM-747 FM unit—great for watching 10-meter repeaters.

You get 20 memories to store frequency and mode. Dual VFOs with split frequency operation for DX-pedition work. And manual band scan plus auto-resume memory scan via the microphone up/down buttons.

Great receiver. Utilizing a directly-driven mixer, the FT-747GX receiver features superb overload protection. You also get factory-installed narrow CW *and* AM filters. A one-touch noise blanker. All-mode squelch. RIT. And a 20-dB attenuator for local QSOs.

Lightweight construction. Housed in a metallized high-impact plastic case, the FT-747GX weighs in at about 7¼ pounds! With the loudspeaker mounted on the front panel for maximum audio transfer. And internal heatsinking for the transmitter, rated at full power for FM, packet, RTTY, SSTV, and AMTOR when used with a heavy-duty power supply.

Available options. FC-1000 or FC-757AT Automatic Antenna Tuners. FL-7000 500-watt Automatic, Solid-State Linear Amplifier. TCXO-747 Temperature-Compensated Crystal Oscillator. FAS-1-4R Remote Antenna Selector. FRB-757 Amplifier Relay Box. FP-700 Standard Power Supply. FP-757HD Heavy-Duty Power Supply. MMB-38 Mobile Mounting Bracket.

Discover the price/performance leader. Check out Yaesu's low-cost FT-747GX at your Yaesu dealer today. Because now, Yaesu puts priceless DX into *your* price range.

Yaesu USA 17210 Edwards Road, Cerritos, CA 90701 (213) 404-2700. **Repair Service:** (213) 404-4884. **Parts:** (213) 404-4847. Prices and specifications subject to change without notice.

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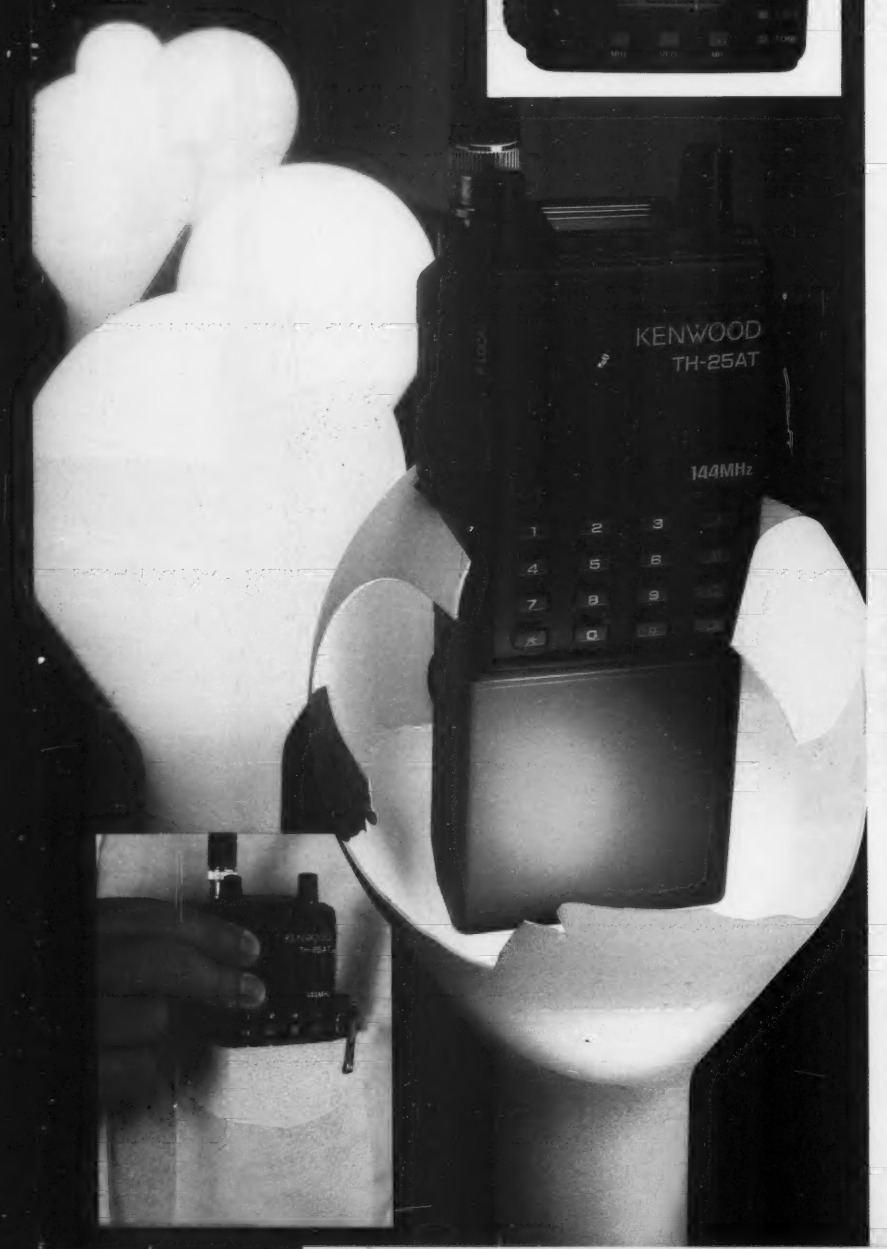

TH-25AT/45AT

New Pocket Portable Transceivers

The all-new TH-25 Series of pocket transceivers is here! Wide-band frequency coverage, LCD display, 5 watt option, plus...

- Frequency coverage: **TH-25AT:** 141-163 MHz (Rx); 144-148 MHz (Tx). (Modifiable for MARS/CAP. Permits required.) **TH-45AT:** 438-450 MHz.
- Automatic Power Control (APC) circuit for reliable RF output and final protection.
- 14 memories; two for **any** "odd split" (5 kHz steps).
- Automatic offset selection (TH-25AT).
- 5 Watts from 12 VDC or PB-8 battery pack.
- Large multi-function LCD display.
- Rotary dial selects memory, frequency, CTCSS and scan direction.
- T-ALERT for quiet monitoring. Tone Alert beeps when squelch is opened.
- Band scan and memory scan.
- Automatic "power off" circuit.
- Water resistant.
- CTCSS encoder/decoder optional (TSU-6).
- **Supplied accessories:** StubbyDuk, PB-6 battery pack for 2.5 watts output, wall charger, belt hook, wrist strap, water resistant dust caps.

Optional accessories:

• **PB-5** 7.2 V, 200 mAh NiCd pack for 2.5 W output • **PB-6** 7.2 V, 600 mAh NiCd pack • **PB-7** 7.2 V, 1100 mAh NiCd pack • **PB-8** 12 V, 600 mAh NiCd for 5 W output • **PB-9** 7.2 V, 600 mAh NiCd with built-in charger • **BC-10** Compact charger • **BC-11** Rapid charger • **BT-6** AAA battery case • **DC-1/PG-2V** DC adapter • **HMC-2** Headset with VOX and PTT • **SC-14, 15, 16** Soft cases • **SMC-30/31** Speaker mics. • **TSU-6** CTCSS decode unit • **WR-1** Water resistant bag

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Complete service manuals are available for all Kenwood transceivers and most accessories. Specifications, features, and prices are subject to change without notice or obligation.